[illegible] ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts

[illegible]

[illegible] Oak Ridge, Tennessee

NUCLEAR SCIENCE ABSTRACTS

Volume 9 May 31, 1955 No. 10

GENERAL

ATOMIC POWER

3356

PROGRAMME FOR NUCLEAR POWER. Research (London) 8, 115-17(1955) Mar.

The proposed program for developing nuclear power stations in Britain is reviewed. Two graphite-moderated gas-cooled reactors are expected to be operating by 1960 or 1961. By 1963, 4 stations are expected to be in operation with a total output of 400 to 800 Mev. The total installed capacity of nuclear stations at the end of the 10 year program should be 1500 to 2000 Mev. The entire capital cost is to be provided by the British Electricity Authority, which will operate the stations. (M.P.G.)

BIOLOGY AND MEDICINE

3357 UCRL-2846

Radiation Lab., Univ. of Calif., Berkeley

THE RELATION OF QUANTUM REQUIREMENT IN PHOTOSYNTHESIS TO RESPIRATION. James A. Bassham, Kazuo Shibata, and M. Calvin. Jan. 21, 1955. 22p. Contract W-7405-eng-48.

The rates of photosynthesis and subsequent respiration of Chlorella pyrenoidosa were measured using an oxygen analyzer (sensitive to paramagnetism). The energy absorbed during the photosynthesis periods was determined and the quantum requirement was calculated. Dark respiration rate was found to depend on the rate of light absorption during the period of photosynthesis, and increased with increasing photosynthesis rate. The quantum requirement, corrected for respiration, varied from 4.9 (at a ratio of photosynthesis to respiration of 1.4) to 6.9 (at a ratio of 12). Both uncorrected and corrected quantum requirements approach an experimental value of 7.4 at high light intensity. The lower quantum requirement obtained at low light intensity is believed to be due to a relatively greater importance of contribution of energy from respiration to photosynthesis. An expression is derived for the relation between this contribution and the enhancement of dark respiration due to the level of photosynthesis to which the plants are conditioned. Attempts to obtain the blue-light stimulation of photosynthesis with algae photosynthesizing in red light were unsuccessful. (auth)

3358

DEVELOPMENT OF METHODS FOR GROWING CULTURES OF SCENEDESMUS QUADRICAUDA AND DAPHNIA LONGISPINA LABELED WITH RADIOACTIVE PHOSPHORUS. N. B. Zavarzina (Inst. of Microbiology, Moscow). Mikrobiologiya 24, 31-5(1955) Jan.-Feb. (In Russian)

AEROSOLS

3359 MLCR-51

Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

A STUDY OF THE MECHANISM OF ABSORPTION OF PARTICULATES IN THE RESPIRATORY TREE. [SECTION I]. QUARTERLY REPORT NO. 4, 1954. (Includes an Appendix: AUTOMATIC ELECTRONICALLY CONTROLLED RESPIRATORY CYCLING VALVE. James Clark). [SECTION II]. A SUMMARY OF REPORTS ISSUED SINCE DECEMBER 1, 1953. Arnold E. Reif, Margot P. Holcomb, Helen S. Baker, and Clayton S. White. Jan. 1955. 51p. For Chemical Corps Medical Labs., Army Chemical Center. Contract DA-18-108-CML-5050.

Design and performance are described of an air-jet nebulizer for the production of water aerosols. Methods are described for determining the particle-size of water aerosols. Design is described of an automatic electronically controlled respiratory cycling valve for animal respirators. A brief summary is included of results from aerosol inhalation studies with rats. (C.H.)

3360 MLCR-53

Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

A STUDY OF THE MECHANISM OF ABSORPTION OF PARTICULATES IN THE RESPIRATORY TREE. PART I. QUARTERLY REPORT NO. 1 [FOR] SEPTEMBER 1–DECEMBER 1, 1953. Arnold E. Reif, Mary C. Elliott, Thomas L. Chiffelle, and Clayton S. White. PART II. QUARTERLY REPORT NO. 2 [FOR] DECEMBER 1, 1953–MARCH 1, 1954. Arnold E. Reif, Thomas L. Chiffelle, Ulrich C. Luft, James Clark, Clayton S. White, Mary C. Elliott, and Helen S. Baker. Jan. 1955. 60p. For Chemical Corps Medical Labs., Army Chemical Center. Contract DA-18-108-Cml-5050.

The operating characteristics of the Roller Particle Size Analyzer were investigated as a means of producing closely sized aerosols. Preliminary results are reported from studies of the pulmonary absorption of various dyes and particles of various sizes in rats and dogs. (C.H.)

3361 AERE-Lib/Trans-481

PAPER FILTERS FOR THE REMOVAL OF MICRO-ORGANISMS AND DUST FROM VENTILATING AIR. A. I. Shafir, P. A. Kouzov, and N. M. Panshinskaya. Translated by J. B. Sykes from Gigiena i Sanit. No. 9, 23-9(1954).

Lignin paper filters were found to give excellent results as a means of sterilizing the air of inhabited rooms. The filters are recommended for use in ventilating systems for the purpose of purifying the air from dust and microörganisms. Impregnation with emulsions of the outer layers of the lignin filters was found to increase the dust-retaining power of the filters. (C.H.)

RADIATION EFFECTS

3362 NM-001.059.13.05

Naval School of Aviation Medicine, Pensacola

THE RATE OF ENERGY LOSS (REL) IN THE TERMINAL

SECTION OF HEAVY NUCLEI TRACKS IN LIVING TISSUE. Hermann J. Schaefer, Naval School of Aviation Medicine, Pensacola and Ernst Stuhlinger, Redstone Arsenal, Huntsville, Ala. Mar. 11, 1953. 19p. (AD-10803)

The possible health hazard resulting from exposure to high-altitude cosmic radiation was investigated. Calculations were made for the rate of energy loss (REL) for the terminal portion of heavy nuclei tracks. The REL was determined as a function of the residual in range in living tissue for Sn, Fe, and Mg. The maximum REL in ion pairs per 10 μ of tissue is given as 1,860,000, 1,590,000, 1,000,000, 734,000, 509,000, and 351,000 for Sn, Nb, Fe, Ca, Mg, and C, respectively. A value of 100,000 is suggested to represent the lower limits of an excessively high REL rate. The maximum of the REL appeared to occur at a considerably lower energy than that of the initial electron capture. (ASTIA abst.)

3363 NM-006-012.04.76
Naval Medical Research Inst., Bethesda
THE COMPARATIVE EFFECT OF PLATELETS ON PROTHROMBIN UTILIZATION FROM DOGS IN THE DEGENERATIVE AND REGENERATIVE PHASE OF IRRADIATION BONE MARROW APLASIA. E. P. Cronkite, G. J. Jacobs, and P. K. Schork. Nov. 11, 1954. 10p.

A relationship between platelet concentration and prothrombin utilization has been reported in normal subjects and in irradiated animals. A parallelism in this relationship was observed in the degenerative but not in the regenerative phase of irradiation sickness. Further study of these phenomena was undertaken. Dogs were exposed to 150, 250, 400, and 600 r. Prothrombin utilization and platelet counts were performed periodically. In the 600 r group, platelet levels were controlled by differential centrifugation. In the other groups, platelet counts varied spontaneously. The results show that prothrombin utilization is dependent upon platelet level which in turn is dependent upon radiation dose. In regeneration, utilization returns to normal faster than the platelets. In whole blood it takes 3 to 3½ times as many platelets for equal utilization in the degenerative as in the regenerative phase. A similar relationship is found when comparing the plasma of the degenerative phase with normal plasma. The reasons for the impaired activity in the degenerative and the superactivity in the regenerative phase is not clear. Superactivity may be correlated with an increased size and lability of platelets. Impaired activity may be better correlated with increased plasma lipid antithromboplastin. Bleeding is best correlated with the duration of thrombopenia below a critical level where spontaneous bleeding becomes possible. (auth)

3364 UCRL-2845
Radiation Lab., Univ. of Calif., Berkeley
VARIATION OF THE BIOLOGICAL EFFECTIVENESS OF X-RAYS AND ALPHA PARTICLES ON HAPLOID SACCHAROMYCES CEREVISIAE. Mortimer M. Elkind and Carl A. Beam. Jan. 21, 1955. 27p. Contract W-7405-eng-48.

The radiosensitivity of haploid Saccharomyces cerevisiae, SC-7, has been studied in the region of exponential survival using 50-kv x rays and 3.4-Mev alpha particles (Po^{210} source). Cells harvested from YED agar (½% yeast extract, 1% dextrose) were used to inoculate a 30° C liquid medium (0.45% YE, 0.91% D). After about 3 to 4 generation times, log phase cells were harvested, washed, and either used to inoculate a starvation medium (5 gm % dextrose in M/20 KH_2PO_4) or used for a fresh-cell survival study. The criterion of biological effect was visible colony formation from irradiated cells plated on YED agar. Although resistance to alpha-particle radiation remained relatively constant for starvation periods up to 9 days, in the same interval the x-ray resistance increased by a factor of 2.5. The relative biological effectiveness (RBE) during this same interval varied from 0.66 to 2.0 with most of the RBE and x-ray radiosensitivity variation occurring within the first three days of starvation. In addition to the RBE and radiosensitivity variation of the exponential portion of the survival curves, it is shown that alpha particles, as do x-rays, display a multiple-hit portion of survival attributable to the budding population, and that the multiple-hit portion can have an RBE > 1 while the single-hit portion has an RBE < 1. (auth)

3365 USNRDL-TR-27
Naval Radiological Defense Lab.
ADRENAL CORTICAL RESPONSE IN THE RAT TO X IRRADIATION IN TERMS OF CORTICOSTERONE LEVELS. F. T. Brayer. Jan. 17, 1955. 18p.

An adaptation of prevailing methods for determining corticosteroids in small amounts of tissue has been described. It was shown that the corticosterone level in the adrenal glands of rats was significantly increased by exposure of the rat to 600 r total-body x irradiation. (auth)

3366
ATOMIC BOMB INJURIES AMONG SURVIVORS IN HIROSHIMA. Mardelle L. Reynolds and Francis X. Lynch. Public Health Repts. (U.S.) 70, 261-70(1955) Mar.

Data pertaining to 6,343 survivors of the atomic explosion in Hiroshima on August 6, 1945, are analyzed with respect to the incidence of mechanical and radiation injuries and flash burns, in relation to distance from ground center and type of protection. (auth)

3367
INACTIVATION OF BACTERIOPHAGES BY DECAY OF INCORPORATED RADIOACTIVE PHOSPHORUS. Gunther S. Stent and Clarence R. Fuerst (Univ. of California, Berkeley). J. Gen. Physiol. 38, 441-58(1955) Mar.

The inactivation of the phages T1, T2, T3, T5, T7, and λ by decay of incorporated P^{32} has been studied. It was found that these phages fall into two classes of sensitivity to P^{32} decay: at the same specific activity of P^{32} in their deoxyribonucleic acid (DNA), T2 and T5 are inactivated three times as rapidly as T1, T3, T7, and λ. Since the strains of the first class were found to contain about three times as much total phosphorus per phage particle as those of the second, it appears that the fraction of all P^{32} disintegrations which are lethal is very nearly the same in all the strains. This fraction α depends on the temperature at which decay is allowed to proceed, being 0.05 at −196°C, 0.1 at +4°C, and 0.3 at 65°C. Decay of P^{32} taking place only after the penetration of the DNA of a radioactive phage particle into the interior of the bacterial cell can still prevent the reproduction of the parental phage, albeit inactivation now proceeds at a slightly reduced rate. T2 phages inactivated by decay of P^{32} can be cross-reactivated; i.e., donate some of their genetic characters to the progeny of a mixed infection with a non-radioactive phage. They do not, however, exhibit any multiplicity reactivation or photoreactivation. The fact that at low temperatures less than one-tenth of the P^{32} disintegrations are lethal to the phage particle and the dependence of the fractio

of lethal disintegrations on temperature can be accounted for by the double stranded structure of the DNA macromolecule. (auth)

3368

RESPONSE TO TOTAL BODY IRRADIATION. Andrew H. Dowdy and Leslie R. Bennett (Univ. of California School of Medicine, Los Angeles). Am. J. Roentgenol. Radium Therapy Nuclear Med. 73, 639-48(1955) Apr.

Present knowledge of radiation biology leads to the conclusion that any amount of radiation energy which is absorbed by the intact living organism may result in damage to one or more biological systems although the injury may or may not be detectable during the lifetime of the individual. Experimental data which form the basis for this conclusion are reviewed. The most commonly observed prompt and late effects of total-body irradiation on mammals are summarized and discussed briefly. 43 references. (C.H.)

3369

THE EFFECTS OF X-RAYS, 2-MEV ELECTRONS, THERMAL NEUTRONS, AND FAST NEUTRONS ON DORMANT SEEDS OF BARLEY. Richard S. Caldecott (Brookhaven National Lab., Upton, N. Y.). Ann. N. Y. Acad. Sci. 59, 514-35(1955) Feb.

RADIATION HAZARDS AND PROTECTION

3370 USNRDL-TR-23

Naval Radiological Defense Lab.

ON THE NATURE OF THE SPLEEN-BONE MARROW RADIATION RECOVERY FACTOR. L. J. Cole and M. E. Ellis. Dec. 13, 1954. 21p.

Since previous data indicate that the radiation recovery factor in the nuclear fraction of mouse spleen homogenates is inactivated by treatment with DNA-ase and with trypsin, it was pertinent to test the hypothesis that intact viable spleen cells are not susceptible to the action of these enzymes. Fresh spleen cells were obtained from gently minced spleen fragments, and incubated with DNA-ase at 25°C for 30 min. Under these conditions only 2 per cent of the total cellular DNA was liberated into the supernatant. In contrast, as much as 45 per cent of the total cellular DNA was solubilized by the action of DNA-ase on spleen homogenates containing the same cell count as the cell suspension. These data support the view that DNA, as present in intact, non-homogenized spleen cells is not available as a substrate for added DNA-ase. Additional evidence has been obtained indicating that the recovery factor in rat bone marrow possesses some properties in common with the factor in mouse spleen. Thus, protective activity of rat bone marrow homogenates injected into homologous x-irradiated rats is associated with the nuclei fraction obtained by differential centrifugation in sucrose-salt medium, and not with the mitochondria, microsome, or supernatant subcellular fraction. Rat bone marrow suspensions lose their protective activity following in vitro x irradiation with 725 r, and marrow removed from irradiated rats two days after exposure is no longer protective. The implications of these experimental data are discussed. (auth)

3371

THE COUNTERACTION BY CYSTEINE OF THE EFFECTS OF X-RAYS AND OF TRYPTOPHAN ON THE ACTION OF SPECIFIC SUPPRESSOR SYSTEMS IN DROSOPHILA MELANOGASTER. Henry L. Plaine (Johns Hopkins Univ., Baltimore). Cancer Research 15, 151-8(1955) Mar.

L-Cysteine was fed to larvae carrying both a suppressor-erupt and a suppressor-tumor system to test its effect in combination with x-ray treatments and with supplementary L-tryptophan in the diet. Cysteine itself had no effect on erupt eyes or on the incidence of melanotic tumors. Fed before or after x-ray treatment, cysteine greatly reduced the radiation effect which blocks the action of the suppressor genes and thus engenders both tumors and erupt eyes. Cysteine was more effective in counteracting the erupt eye effect when fed before the x-ray treatment; but it appeared to be more effective against the tumorigenic effect if fed after the x-ray treatment. The greatest protective effect was obtained when cysteine was fed both before and after the x-ray treatment, the incidence of tumors being reduced from 78 per cent to 13 per cent and that of erupt eyes from 90 per cent to 14 per cent when the larvae were x-rayed 24 hours after hatching. Cysteine, to a considerable degree, counteracted the harmful effects of x rays on viability, particularly those which occurred during the pupal period. Cysteine likewise counteracted in all respects the effects of feeding supplementary tryptophan. The feeding of L-tryptophan (0.5 per cent) plus L-cysteine (0.1 per cent) led to a significant reduction in the incidence of tumors from 63 per cent to 24 per cent and in the incidence of erupt eyes from 52 per cent to 7 per cent. The toxicity of tryptophan, during the pupal stage, was greatly reduced when cysteine was added to the medium. In all respects, the interaction of tryptophan with oxygen or cysteine is strikingly like that of x rays with oxygen and cysteine. This might imply the operation of a similar mechanism in these cases. (auth)

3372

RADIATION PROTECTION PROBLEMS IN DIAGNOSTIC ROENTGENOLOGY. George C. Henny (Temple Univ. School of Medicine, Philadelphia). Am. J. Roentgenol. Radium Therapy Nuclear Med. 73, 649-54(1955) Apr.

Many of the protection problems that have to be solved in diagnostic roentgenology have been presented. These can be solved by attention to details of technique, by interposition of adequate protective barriers, and by increase of distance from the scattering object when possible. The principles have been discussed upon which changes of quality of the roentgen-ray beam may be used to protect both the patient and the roentgenologist. (auth)

3373

RADIATION PROTECTION IN THERAPEUTIC RADIOLOGY. H. O. Wyckoff (National Bureau of Standards, Washington, D. C.). Am. J. Roentgenol. Radium Therapy Nuclear Med. 73, 655-60(1955) Apr.

Problems of protection associated with the use of therapeutic radiation equipment are reviewed. (C.H.)

RADIATION SICKNESS

3374 AERE-Lib/Trans-470

THE X-RAY PHOTOGRAPH FROM THE DOSIMETRIC STANDPOINT. G. Spiegler. Translated by F. Hudswell from Fortschr. Gebiete Röntgenstrahlen 80, 754-62(1954). 8p.

Methods applicable to the calibration of diagnostic x rays in mr-sec are discussed and recommended for estimating the hazards of diagnostic radiology for patients and personnel. (C.H.)

TOXICOLOGY STUDIES

3375

INDUSTRIAL HYGIENE AND MEDICAL SURVEY OF A THORIUM REFINERY. Roy Albert, Paul Klevin, James Fresco, John Harley, William Harris, and Merril Eisenbud (U. S. Atomic Energy Commission, New York Operations Office). Arch. Ind. Health 11, 234-42(1955) Mar.

The study of a thorium refinery in operation for 30 years revealed thorium exposures considerably in excess of currently acceptable standards for uranium. However, there was no evidence of overt industrial disease. (auth)

TRACER APPLICATIONS

3376 NYO-4916

Atomic Energy Medical Research Project, Western Reserve Univ.

INCORPORATION OF FORMATE-C^{14} AND BICARBONATE C^{14} INTO NORMAL AND X-IRRADIATED CHICK EMBRYOS. Paul S. Lavik. Mar. 10, 1955. 17p. Contract W-31-109-eng-78.

Embryonated eggs were subjected to 450-r x irradiation on the 11th day of incubation. Promptly thereafter these and a comparable group of unirradiated eggs were inoculated with formate-C^{14} or bicarbonate-C^{14}, and the incorporation of isotope into the RNA (ribonucleic acid) and DNA (desoxyribonucleic acid) bases was determined. In the embryos given formate-C^{14}, the isotope content of the RNA purines in the irradiated embryos was either normal or, temporarily, elevated. The purines and thymine in the DNA of the irradiated embryos contained appreciably less isotope than the controls after a 2-day, as well as a 5-day incorporation period. The specific activities of the RNA purines and pyrimidines 48 hours after bicarbonate-C^{14} administration were essentially the same in the control and irradiated embryos, and the DNA pyrimidines were also labeled about equally in the 2 groups. However, the DNA adenine and guanine were approximately 7 and 2 times, respectively, more radioactive in the irradiated embryos than in the controls. Further experiments will determine whether the latter effect represents a retention of isotope or an enhanced incorporation of bicarbonate-C^{14} into the DNA purines of the irradiated embryos. (auth)

3377 UCRL-2827

Radiation Lab., Univ. of Calif., Berkeley

THE RENEWAL OF NUCLEOTIDES AND NUCLEIC ACIDS IN THE C_{57} MOUSE STUDIED WITH ADENINE-4, 6-C_1^{14}. Edward L. Bennett and Barbara J. Krueckel. Jan. 13, 1955. 28p. Contract W-7405-eng-48.

Adenine has been shown to be extensively utilized for the formation of acid-soluble adenine nucleotides and for the formation of RNA and DNA in the C_{57} mouse. The apparent half lives of the adenine in the nucleotides, RNA, and DNA of the organs of the mouse have been calculated, and a fast and a slow component adenine were found in the adenine-containing fractions in several tissues. Evidence is presented that soluble adenine nucleotides serve as precursors for RNA and DNA, and that the equilibration of nucleotides with RNA is relatively rapid in the large and small intestines and probably also in the bone marrow. (auth)

3378

INTRAPROSTATIC INJECTION OF RADIOACTIVE YTTRIUM CHLORIDE IN THE DOG. George J. Bulkley, John A. D. Cooper, and V. J. O'Conor (Northwestern Univ. Medical School, Chicago). Surg. Gynecol. Obstet. 100, 405-8(1955) Apr.

The excretion and distribution of radioactive yttrium chloride after intraprostatic injection in the dog have been studied. Approximately one-half of the injected radioactivity is excreted in the urine, the major portion during the first 48 hours. One-third of the radioactivity remaining in the body was found in the prostate with only small amounts in distant organs. Radiation effects observed in the prostate initially were characterized by hemorrhage and necrosis followed by healing with fibrous replacement of glandular tissue. Uniform distribution of the radioactive material through the parenchyma of the gland could not be achieved. High levels of radioactivity were found in the regional lymphatics and tissues of the pelvis in over half of the animals. (auth)

3379

THE DETERMINATION OF ^{65}Zn IN TISSUES WITH GEIGER AND SCINTILLATION COUNTERS. T. E. Banks, R. Tupper, R. W. E. Watts, and A. Wormall (Medical Coll. of St. Bartholomew's Hosp., London). Biochem. J. 59, 149-52(1955) Jan.

A simplified method of determining the Zn^{65} content of tissues, using the Veall-type liquid counter, is described. A scintillation counter suitable for the measurement of Zn^{65} present in fluids or tissue homogenates is described. The special advantages of the scintillation counter in biological work with radioactive isotopes are briefly discussed. (auth)

CHEMISTRY

3380 AD-12451

Institute of Industrial Research, Univ. of Louisville

A STUDY OF SELECTED METALLIC BORIDES, NITRIDES, AND PHOSPHIDES. FINAL REPORT. R. W. F. Morel, G[ordon] C. Williams, and F. E. Ryerson. [1952?]. 60p. Contract N8onr-80200.

Attempts were made to prepare the nitrides of Mo, Pd, Ta, V, and Zr and the borides of Mo, Ta, Th, V, and Zr. Mo_2N_4 was not formed by reacting MoO_3 with NH_3 gas, with or without C. The reaction of $MoCl_2$ with NH_3 gas produced small amounts of Mo_2N_4; heating Mo to 900°C in a stream of NH_3 gas yielded a bulk sample of Mo_2N_4 containing 88.5% Mo and 9.77% N. The double decomposition of Ca_3N_2 and V_2O_5 yielded 88% VN. An appreciable quantity of VN was produced by the reaction involving metallic V and NH_3 at 1600°F; however, separation of the hydride which was also produced was impractical. Heating of $V_2O_2Cl_4$ in a stream of NH_3 gas produced appreciable amounts of VN. The double decomposition of Ca_3N_2 and ZrO_2 or $ZrCl_4$ and the reduction of $ZrCl_4$ by NH_3 were unsatisfactory methods for obtaining ZrN. A large sample of ZrN, 70% pure, was prepared by the use of Zr metal as a heating element in an NH_3 gas-filled chamber. The work on Ta_3N_5 and Pd nitride preparation was not sufficiently advanced to develop methods for preparing bulk samples. Fusion of elemental powders of Mo and B failed to yield Mo boride. TaC formed in the furnace reaction of Ta_2O_5 and B in a graphite crucible. When Th and B were heated together in a graphite-helix resistance furnace, ThO_2 predominated. X-ray diffraction patterns were used unsuccessfully to identify the compounds resulting from attempts to obtain V boride and Zr_3B_4. (auth)

3381 AECU-3007

Institute for the Study of Rate Processes, Univ. of Utah

A KINETIC STUDY OF THE OXIDATION OF SPHALERITE. PART II. TECHNICAL REPORT NO. XVIII. John N. Ong, Jr., Milton E. Wadsworth, and W. Martin Fassell, Jr. Feb. 7, 1955. 20p. Contract AT(11-1)-82.

The temperature and oxygen concentration dependence on the reaction of sphalerite in oxygen at pressures from 6 to 640 mm Hg have been investigated in the temperature range 700 to 870°C. Sphalerite has been found to oxidize linearly over this entire temperature and pressure range. At higher rates considerable self-heating was observed. The dependence of the oxidation rate on the oxygen concentration may be expressed by: Rate = $k'\Theta$, where k' is the specific rate constant and $\Theta = K_1[O_2]/(1+K_1[O_2])$, where K_1 is the equilibrium constant for the adsorption of oxygen on sphalerite. Values of the activation energy and the enthalpy of adsorption were found to be 60.3 and -59.6 kcal/mole, respectively. Data have been presented indicating conditions under which either a sulfatizing or an oxidizing rate may be obtained. (For preceding report in series see AECU-2881.) (auth)

3382 NP-5563

Stanford Research Inst.

DETERMINATION OF THE MECHANISM OF THE INCREASE OF VISCOSITY OF ORGANOSILICON COMPOUNDS AT HIGH TEMPERATURES. QUARTERLY PROGRESS REPORT [FOR] SEPTEMBER 30, 1954 TO DECEMBER 31, 1954. REPORT NO. 36. E. E. Ryskiewicz. Mar. 11, 1955. 15p. Contract AF33(616)-168.

Study of the oxidation of the tetrapentoxysilanes has been completed. There is an apparent correlation at 120°C between oxidation rate and chemical structure for these tetrapentoxysilanes. At this time no correlation has been found between hydrolysis rates and chemical structure. Preliminary experiments have indicated that the oscillometer is not useful in this project for the measurement of hydrolysis rates. A study has been initiated on the effect of certain antioxidants on the rate of oxidation of the tetrapentoxysilanes. (auth)

3383 NP-5568

Massachusetts Inst. of Tech.

[STABILITY AND REACTION STUDIES OF HYDROGEN PEROXIDE]. REPORT NO. 44. HYDROGEN PEROXIDE. PART 3. (CHAPTERS 7-8). W. C. Schumb, C. N. Satterfield, and R. L. Wentworth. Dec. 31, 1954. 238p. Contract N5ori-07819.

This section of the monograph on fundamental studies of the properties, formation, and reactions of hydrogen peroxide includes information appearing in the literature up to July 1, 1954, covering chemical properties and decomposition processes. 805 references. (cf. NP-5425.) (C.H.)

3384 ORNL-1848

Oak Ridge National Lab.

THE SYSTEM UO_2CrO_4—H_2O. F. J. Loprest, W. L. Marshall, and C. H. Secoy. Mar. 25, 1955. 14p. Contract W-7405-eng-26.

Preparation of UO_2CrO_4 is described. Phase equilibria in the system uranyl chromate—water was studied from 0°C to the ice eutectic at -0.145°C and to temperatures at which hydrolytic precipitation of an uncharacterized solid phase occurs. The solubility of $UO_2CrO_4 \cdot 5\frac{1}{2}H_2O$ exhibits a marked increase with temperature from 3.11 at 0° to 70.4 wt. % of uranyl chromate at 66°C. A transition between the $5\frac{1}{2}H_2O$ hydrate and a lower hydrate (probably $1H_2O$) occurs at 66.3°C. The solubility of the latter solid exhibits practically no variation with temperature. (auth)

3385 RDB(Cap)/R-8120

Research and Development Branch, Industrial Group, Capenhurst Works, United Kingdom Atomic Energy Authority, Capenhurst, Ches. (England)

A KINETIC STUDY OF THE FLUORINATION OF URANIUM TETRAFLUORIDE BY FLUORINE. V. Y. Labaton. Jan. 1955. 28p.

The reaction between uranium tetrafluoride and fluorine has been studied over a range of temperature by following the change in weight of the solid phase. A mixture of nitrogen and fluorine was flowed over a thin layer of uranium tetrafluoride contained in a aluminium pan. The pan was suspended from the end of a calibrated beryllium—copper spring balance in a reactor tube heated by a vapor jacket. Prior to this study it was the general belief that hex was produced in two steps: $2UF_4 + F_2 \rightarrow 2UF_5$ and $2UF_5 + F_2 \rightarrow 2UF_6$. It has now been established that hex is produced almost entirely in a single step reaction: $UF_4 + F_2 \rightarrow UF_6$. The reaction is complicated by the effect of diffusion of fluoride ions into the solid particles and by the possible reaction between uranium tetrafluoride and hex. The hex production rate is in agreement with the kinetics expected for reaction between a gas and a solid at a continuously diminishing spherical interface, except for small deviations at the beginning and end of the reaction. The reaction is temperature dependent and no reaction is detectable below 220°C. The Arrhenius relationship holds between the reaction rate constant and the temperature of the reaction. The activation energies determined for three preparations of uranium tetrafluoride are: material prepared by dehydration of $2UF_4 \cdot 5H_2O$, 15.5 kcal per mole, by dryway process, 19.1 kcal per mole, and by sublimation of dryway material, 19.9 kcal per mole. A linear relationship has been shown to exist between the reaction rate and partial pressure of fluorine, but the reaction rate is not affected by the velocity of gaseous reactant past the solid. The initial rate of hex production is dependent on the effective surface area of the uranium tetrafluoride. (auth)

3386 WADC-TR-53-308(Pt.1)

Cincinnati Univ.

DENSITY AND VISCOSITY OF MOLTEN MATERIALS. PART 1. DENSITY OF SODIUM AND SODIUM HYDROXIDE. M. Nishibayashi. Nov. 1953. 53p. Contract AF33(616)-9. (AD-26029)

The densities of molten sodium and sodium hydroxide were measured over the temperature range of 254 to 860°C, and 447 to 736°C, respectively. The determinations were made by Kohlrausch's hydrostatic weighing method utilizing the Archimedes principle. The apparatus used was a refinement of the commonly known Mohr-Westphal balance where a chainomatic analytical balance was used as the weighing mechanism for increased accuracy. The equations, $d_{Na} = (0.9378 \pm 0.0086) - (0.000268 \pm 0.000018)(t - 97.5)$ and $d_{NaOH} = (1.753 \pm 0.002) - (0.000565 \pm 0.000008)(t - 318.4)$ were derived by the method of least squares from the data accumulated. (auth)

3387 AEC-tr-2101

COMPUTING DEVICES FOR THE SOLUTION OF PROBLEMS IN CHEMICAL ENGINEERING TECHNOLOGY. Otto Fuchs. Translated from Chem. Ing. Tech. 25, 377-85(1953). 40p.

The use of digital and analog computers in the solution of chemical engineering problems is reviewed. Digital computers are well suited for the calculation of distillation, absorption, and extraction processes and for the determination of chemical equilibria. Analog computers can be applied to problems in kinetics, distillation, spectroscopy, geology, liquid-vapor equilibria, and elasticity. The techniques for solving a few specific problems by means of computers are described in detail with frequent reference to figures. No figures are included in the translation. Approximately 50 references to books and articles are given. (M.P.G.)

3388 AEC-tr-2102

RUTOSIDE AND FLAVONIC DERIVATIVES. R. Moers. Translated from J. Pharm. Belg. 8, 44-58(1954). 16p.

Flavonic derivatives exist in many plants. Endowed with related properties, they give on hydrolysis an aglucone with a γ-benzopyrone nucleus and sugar molecules. Rutoside, which enjoys present favor, is one of these products. Its extraction, identification, and determination were studied by means of chromatography and spectrography. The products encountered in commerce, such as eriodictyol, hesperidoside, quercetin, and esculoside have been reviewed. These compounds, to varying degrees, increase the strength and decrease the permeability of the capillaries. (auth)

3389

PREDISSOCIATIONS OF THE $C^{12}O$ AND $C^{13}O$ MOLECULES. A. E. Douglas and C. K. Møller (National Research Council, Ottawa, Ontario, Canada). Can. J. Phys. 33, 125-32(1955) Mar.-Apr.

The Angström bands of $C^{12}O$ and $C^{13}O$ have been photographed with a high-dispersion spectrograph, and the predissociations previously reported in these bands have been re-examined. The predissociations provide good evidence that $C^{12}O$ has a dissociation limit 89595 ± 30 cm^{-1} above the $v = 0$ level of the ground state. The fourth positive ($A^1\Pi - X^1\Sigma$) bands have been re-examined, and it has been shown that, contrary to earlier reports, there is no evidence for predissociation in the $A^1\Pi$ state. (auth)

3390

STUDIES ON COORDINATION COMPOUNDS. XIV. THE DETERMINATION OF ENTHALPY AND ENTROPY VALUES FOR SEVERAL BIVALENT METAL IONS AND CERIUM(III) WITH THE ACETYLACETONATE ION. Reed M. Izatt, W. Conard Fernelius and B. P. Block (Pennsylvania State Univ., State College). J. Phys. Chem. 59, 235-7(1955) Mar.

Thermodynamic stepwise equilibrium formation constants are given for the reaction in aqueous solution of the acetylacetonate ion with Cu^{2+}, Be^{2+}, UO_2^{2+}, Ni^{2+}, Co^{2+}, Zn^{2+}, Mn^{2+}, Cd^{2+}, Mg^{2+}, and Ce^{3+} at 10, 20, and 40°. Values of the thermodynamic quantities, ΔH, ΔS and ΔF are given over the temperature range 10 to 40° for the formation of the first complex, $MCh^{(n-1)+}$, in each case (except UO_2^{2+}), of $MCh_2^{(n-2)+}$ in each case (except Zn^{2+} and Cd^{2+}), and of MCh_3^- in the case of Ni^{2+}. Values for these thermodynamic quantities are also given for the dissociation of acetylacetone over the above temperature range. The significance of the values obtained is discussed in the light of the reactions involved. Comparisons are made with other thermodynamic values in the literature involving several of these same ions with other ligand types. (auth)

3391

THE KINETICS OF ISOTOPIC EXCHANGE REACTIONS. C. A. Bunton, D. P. Craig, and E. A. Halevi (Univ. Coll., London, Univ. of Sydney, and Hebrew Univ., Jerusalem). Trans. Faraday Soc. 51, 196-204(1955) Feb.

The kinetics of the general associative exchange of a labelled atom X* between two molecular species AX_n and BX_m are developed on the basis of simplifying assumptions relating the distribution of labels within each species and the various rate coefficients governing the reaction. An expression for the rate of exchange is derived which is a function of the isotopic abundance and the equilibrium constant of the exchange. The dissociative exchange of X* between the species AX_n and X is treated in a similar way, and the rate is shown to be given by the same expression modified by a factor that is a function of the rate coefficients. Both expressions reduce in the limit of negligible isotope effect to the accepted McKay relation, and for low abundance of labelled atoms, to the first-order relation deduced by Harris for the simple case n = m = 1. The effect of various factors on the kinetic form is discussed, and it is shown that under most conditions likely to be realized in practice neither deviation from first-order kinetics as a result of isotopic fractionation nor difference in the kinetic form due to the mechanism of exchange should be observed. (auth)

3392

A THEORETICAL TREATMENT OF CATION EXCHANGERS. III. THE HYDRATION OF CATIONS IN POLYSTYRENE SULPHONATES. E. Glueckauf and G. P. Kitt (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Roy. Soc. (London) A228, 322-41 (1955) Mar. 8.

The adsorption of water by the polystyrene sulfonates of cations has been investigated at 0 and 25°C, using an isopiestic method. The adsorption isotherm and the heats (enthalpies) and entropies of hydration have been obtained for the monovalent cations H, Li, Na, K, Cs, NH_4, Ag and for the divalent cations Be, Mg, Ca, Sr, Ba, Hg. With the exception of H, which gives a smooth enthalpy-water-content curve, all monovalent cations show a more or less marked step in the differential enthalpy of adsorbed water between the first and second water molecule adsorbed per ion, thereafter the steps are less clearly defined. The differential entropies show similarities to those calculated for a B.E.T. isotherm, except that the curves show two minima which correspond to approximately 0.5 and 1.5 molecules of water/ion. The adsorption isotherms follow more or less the model of the B.E.T. isotherm, with several significant differences: the volatility of the second and further water molecule/ion is not that of liquid water, but only tends to reach this value after several molecules/ion are adsorbed, and the energy levels of the first successive water molecules, though rising rapidly, differ substantially from that of liquid water. The adsorption process of the first water molecule is significantly different from a Langmuir mechanism, and varies approximately as the one-half power of the water activity. The knowledge of the free energies, enthalpies and entropies permits a fair analysis of the hydration mechanism into its individual steps, which then permits a calculation of the standard state enthalpies and entropies of the first hydration steps. Both functions show a markedly linear relationship with

the ionic radius of the unhydrated ion when summed up for the first two water molecules adsorbed. The knowledge of the adsorption isotherms permits one to differentiate between water adsorbed with zero free energy (swelling water) and the excess adsorbed water (cationic and anionic hydration water). The amount of hydration water associated with the cations has been obtained in this way both for mono- and divalent ions. The amount varies both with the water activity and with temperature. It is clear from the small free energies of hydration of all monovalent ions that the association of almost all water molecules is very loose, and is not related to the co-ordination number of the ions. (auth)

3393

THE HEAT CAPACITY OF NICKEL CARBONYL AND THE THERMODYNAMICS OF ITS FORMATION FROM NICKEL AND CARBON MONOXIDE. J. E. Spice, L. A. K. Staveley, and G. A. Harrow (Inorganic Chemistry Lab., Oxford and Univ. of Liverpool, England). J. Chem. Soc. (London), 100-4(1955) Jan.

Values are given for the heat of fusion of nickel carbonyl, for its melting point, and for its heat capacity between 90 and 270°K. Some discussion follows on the thermodynamics of the reaction $Ni + 4CO \rightleftharpoons Ni(CO)_4(g)$. (auth)

ANALYTICAL PROCEDURES

3394 AD-22921

Research Inst., Temple Univ.

ISOTOPIC DETERMINATION OF IMPURITIES IN METALS. FINAL REPORT [FOR APRIL 1, 1951 TO SEPTEMBER 1, 1953]. Abraham D. Kirshenbaum. Sept. 1, 1953. 32p. Contract AF33(038)-21826.

An isotopic method is described for determining O values in metals or metal oxides with a speed (2 to 3 hr) and accuracy unattainable in other methods. The method uses O^{18} and does not require complete recovery of all the O in the metal. The only requirement of this method is complete statistical exchange between all the O atoms of the various O-containing compounds (metal oxides, CO, and CO_2). Satisfactory results were obtained with this method for several Cu–O and Fe–O alloys and for Cu and Fe oxides in the range from 0.025 to 30 wt. % O; for Cr–O alloys in the range from 0.8 to 2.0 wt. % O, and for Zr–O and Fe–O alloys and their oxides in the range of 0.2 to 26 wt. % O. 38 references. (ASTIA abst.)

3395

DIFFERENTIAL MEASUREMENTS OF REFLECTANCE. C. A. Lermond and L. B. Rogers (Massachusetts Inst. of Tech., Cambridge). Anal. Chem. 27, 340-6(1955) Mar.

Reflectance has been explored as a possible means of making direct analyses of difficultly soluble solid mixtures and of substances on chromatograms. For dyed samples of cloth and yarn, differential spectrophotometric measurements of reflectance make possible the more precise determination of small differences in regions of low reflectance. The results can also be interpreted readily in terms familiar to persons interested in defining color differences. A similar study on synthetic mixtures of pigments has shown that analytically useful data can usually be obtained with samples in powdered form. (auth)

3396

INSTRUMENTAL VARIABILITY OF A MODEL 7 COLEMAN PHOTONEPHELOMETER. Hubert J. Keily and L. B. Rogers (Massachusetts Inst. of Tech., Cambridge). Anal. Chem. 27, 459-61(1955) Mar.

Instrumental variability is attributed to variations in the blanks used to set the instrument sensitivity and to a tendency for the readings to drift to lower values. By modifying the manufacturer's operations and making frequent checks against standards, a standard deviation for individual measurements of 0.28 reading unit at the normal instrument sensitivity has been estimated. (auth)

3397

SALT BRIDGES OF POROUS GLASS AND ION EXCHANGE MEMBRANES. W. N. Carson, Jr., C. E. Michelson, and Karl Koyama (Hanford Atomic Products Operation, Richland, Wash.). Anal. Chem. 27, 472-3(1955) Mar.

The design and properties of porous glass and ion-exchange membrane salt bridges for use in electrometric analysis are presented. Designs for reference half-cells using the porous glass bridges are shown. (J.A.G.)

3398

AUTOMATIC MICROMUFFLE FOR DETERMINATION OF ASH IN CARBONACEOUS MATERIAL. Robert Meyrowitz and C. J. Massoni (U. S. Geological Survey, Washington, D. C.). Anal. Chem. 27, 475-6(1955) Mar.

The design and calibration of an automatic microcombustion apparatus for the determination of the ash content of small amounts of carbonaceous materials are described. The micromuffle consists of an electric, single-speed furnace drive and the moving, short-furnace section of an automatic micro- and semimicrocombustion apparatus. The furnace is of the radiant-heating type, with hinged shell and open-sided heating elements, and operates on a 115-v, 60-cycle, a-c circuit. The maximum temperature for continuous operation is 900°C. (J.A.G.)

3399

CONTINUOUS ANALYSIS OF ORTHO-PARAHYDROGEN MIXTURES. D. H. Weitzel and L. E. White (National Bureau of Standards, Boulder, Colo.). Rev. Sci. Instr. 26, 290-2 (1955) Mar.

A Gow-Mac thermal conductivity unit has been utilized in the construction of a continuous flow analyzer for ortho-parahydrogen mixtures. No pump or vacuum system is required. The unit possesses adequate sensitivity for operation at room temperature, thus eliminating the need for low temperature baths. Parameters which influence reproducibility have been investigated and simple techniques for their control are suggested. (auth)

3400

QUANTITATIVE ANALYSIS OF MIXTURES OF SODIUM, POTASSIUM, MAGNESIUM, AND CALCIUM BY PAPER CHROMATOGRAPHY. D. R. Tristram and C. S. G. Phillips (Inorganic Chemistry Lab., Oxford, England). J. Chem. Soc. (London), 580-1(1955) Feb.

3401

INDIRECT DETERMINATION OF MOLYBDENUM BY A COMPLEXOMETRIC METHOD. Arthur de Sousa (Laboratoire de Chimie Analytique, Lisbonne, Portugal). Anal. Chim. Acta 12, 215-17(1955) Mar. (In French)

A simple and speedy method is given for indirect determinations of molybdenum. The separation of molybdenum (in the form of calcium molybdate) is obtained by precipitation with calcium chloride. The precipitate is dissolved on adding hot I : I HCl. On evaporating the solution one obtains molybdenic acid and calcium chloride. In determining the calcium complexometrically one also determines indirectly the mo-

lybdenum. This method can be used for the ores and alloys of molybdenum. (auth)

3402

ANALYTICAL APPLICATIONS OF THE BARKER SQUARE-WAVE POLAROGRAPH. D. J. Ferrett and G. W. C. Milner (Atomic Energy Research Establishment, Harwell, Berks, England). Analyst 80, 132-40(1955) Feb.

This paper describes the application of the Barker square-wave polarograph to a number of analytical problems and thereby demonstrates some of the advantages of this new technique over conventional polarography. The instrument is especially suitable for the analysis of alloys, and the first application cited describes the direct determination of the copper, lead, cadmium, and zinc contents (0.002 to 1 per cent) of a number of light alloys. Although some of these alloys contained about 4% of copper, it was still possible to determine lead contents of the order of 0.01% without preliminary separation. The reversible reduction wave of nickel in alkaline cyanide has been used for the direct determination of this element (0.048%) in aluminium alloys in the presence of other constituents, including manganese (0.67%). The great sensitivity of this new instrument has made possible the determination of the copper and lead contents (5 to 0.1 ppm) of a number of polarographically important analytical reagents. The behavior of uranium has also been studied. (auth)

3403

THE USE OF HAEMATOXYLIN AS INDICATOR FOR THE VOLUMETRIC DETERMINATION OF ALUMINIUM WITH ETHYLENEDIAMINETETRAACETIC ACID. M. P. Taylor (Beecham Research Labs. Ltd., Brockham Park, Betchworth, Surrey, England). Analyst 80, 153-5(1955) Feb.

3404

APPLICATION OF PAPER-CHROMATOGRAPHIC METHODS OF ANALYSIS TO GEOCHEMICAL PROSPECTING. E. C. Hunt, A. A. North, and R. A. Wells (Chemical Research Lab., Teddington, Middlesex, England). Analyst 80, 172-94(1955) Mar.

Rapid and simple methods are described for the determination of copper, cobalt, nickel, niobium, tantalum, lead, and uranium in soil samples. Following the breakdown of the samples and dissolution of the trace metals by methods applicable in the field, the trace metal or metals are separated chromatographically by upward diffusion of a solvent on slotted sheets of paper which enable ten separations to be performed simultaneously. The metals are detected by spraying the strips with suitable reagents and the amount present is determined by visual comparison with standards. Copper, cobalt, and nickel are determined after a single separation. The same soil extract is used for the determination of both niobium and tantalum. (auth)

3405

SIMULTANEOUS ABSORPTIOMETRIC DETERMINATION OF TANTALUM AND NIOBIUM IN ORES. A. E. O. Marzys (Uganda Development Corp., Ltd., Entebbe). Analyst 80, 194-202(1955) Mar.

The thiocyanate–acetone method for niobium is combined with a modified procedure for determining tantalum with pyrogallol, making it possible to carry out both determinations on one sample solution. The titanium content of the solution is determined on another aliquot for use in applying a correction and, except in the case of low-grade soils, it represents the total titanium content figure of the sample. Tartaric acid is used for the first time as extracting medium for the pyrogallol method, in which the use of 4N hydrochloric acid and of a suitable combination of ammonium oxalate added to tartaric acid gives a maximum absorption peak at 350 mμ, considerably reducing titanium interference and eliminating the interference due to niobium. The procedures for niobium and titanium are based on those described in a previous paper. The method is adapted for use with a spectrophotometer or a filter-type absorptiometer. No chemical separations are necessary for elements commonly occurring in earth-acid ores. The procedure is suitable for both low and high-grade ores. (auth)

3406

AN IMPROVED APPARATUS FOR THE DETERMINATION OF GASEOUS ELEMENTS IN METALS BY VACUUM FUSION ON A MICRO SCALE. J. N. Gregory and D. Mapper (Atomic Energy Research Establishment, Harwell, Berks, England). Analyst 80, 225-30(1955) Mar.

This paper describes some improvements to a vacuum fusion apparatus previously described by the authors in Analyst 78, 414(1953). The improvements relate mainly to more efficient pumping and recovery of the evolved gases, and the introduction of a low-pressure method of gas analysis. Complete results on a series of samples have been obtained in about half a day. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

3407 AD-10920

Research Foundation, Ohio State Univ.

ORDER-DISORDER TRANSFORMATIONS IN CRYSTALS. TECHNICAL REPORT NO. 2. AMPLITUDES OF VIBRATION AND X-RAY SCATTERING OF CRYSTALLINE LITHIUM HYDRIDE AND LITHIUM DEUTERIDE: 300°K TO 20°K. C. K. Stambaugh and P. M. Harris. Jan. 1953. 50p. Contract N6onr 225-17.

Intensities of Laue-Bragg scattering from powdered crystals of LiH and LiD were obtained at 20, 77, 194, and 303°K with a recording G-M counter spectrometer and a special Dewar specimen mount. Relative crystal-structure factors and relative atomic form factors were calculated from the intensities; absolute atomic form factors and characteristic temperatures were obtained from the relative form-factor values. Temperature coefficients and amplitudes of vibration were calculated from the characteristic temperatures. Electron-density distributions for LiH, obtained from the absolute atomic-form-factor data, were used to calculate radial charge distributions. Evidence was discovered which suggested a change in the ionization state of the crystals with changes in temperature. (ASTIA abst.)

3408 NP-5567

Laboratory for Insulation Research, Mass. Inst. of Tech.

PRECISION DETERMINATION OF LATTICE CONSTANTS WITH A GEIGER-COUNTER X-RAY DIFFRACTOMETER. TECHNICAL REPORT NO. 92. A. Smakula and J. Kalnajs. Feb. 1955. 29p. Contracts N5ori-07801 and DA-19-020-ORD-3429.

It is shown that the Geiger-counter x-ray diffractometer can be used for precision determination of lattice constants of single crystals. The zero point of the goniometer and the position of the diffraction lines have been obtained with an accuracy of ±0.001°. The temperature was kept constant by a special unit within 0.05°C. An investigation of

the systematic errors has been made, which shows that the extrapolation of lattice constants vs. $\cos^2 \theta$, according to Wilson's equation, is permissible and the vertical divergence error, as computed by Eastabrook, lies up to $2\theta = 165°$, within the limits of error, and may be neglected. The lattice constants of Al, Ag, Ge, Si, CaF_2, CsI, TlCl, and TlBr, determined by extrapolation, are in good agreement with published data. The limiting factor in the accuracy of the lattice constants determination is not in the error of the diffractometer, but in the x-ray wavelength. (auth)

DEUTERIUM AND DEUTERIUM COMPOUNDS

3409

THE VAPOR PHASE ASSOCIATION OF ACETIC-d_3 ACID-d. A. E. Potter, Jr., Paul Bender, and H. L. Ritter (Univ. of Wisconsin, Madison). J. Phys. Chem. 59, 250-4(1955) Mar.

The vapor density of acetic-d_3 acid-d ($CH_3^2COOH^2$) is reported as measured in the ranges 100 to 800 mm pressure and 80 to 170°. The data are best explained by the assumption that the vapor is an equilibrium mixture of 1-, 2-, and 3-mer. The calculated heats of di- and trimerization are −14,100 and −23,200 cal/mole. The data of Ritter and Simons on CH_3COOH have been recomputed on the basis of new vapor pressure values and the ordinary acid has been shown to contain the same molecular species as the deuteroacid. Corresponding values for the heats of di- and trimerization are −13,700 and −22,800 cal/mole. The difference between the heats of dimerization for $CH_3^1COOH^1$ and $CH_3^2COOH^2$ is accounted for approximately as a difference in the zero-point vibrational energies of the two dimers. A discussion is given of an observation of Johnson and Nash that the logarithm of the apparent equilibrium constant for dimerization is linearly related to the vapor density. (auth)

FLUORINE AND FLUORINE COMPOUNDS

3410 K-1204

Carbide and Carbon Chemicals Co. (K-25)

THE INFRARED SPECTRA AND MOLECULAR STRUCTURE OF SELENIUM HEXAFLUORIDE AND TELLURIUM HEXAFLUORIDE. Taylor George Burke. Mar. 17, 1955. 64p. Contract W-7405-eng-26.

The infrared absorption spectra of gaseous selenium hexafluoride and tellurium hexafluoride have been reinvestigated in the region from 2 to 25μ and extended to 38μ. The spectra reported by Sachsse and Bartholome do not at all resemble the ones from the present investigation, which are substantially the same, in gross features, as the recently reported observations by Gaunt. With the aid of the Raman data the observed spectra have been interpreted in detail on the basis that both molecules belong to the point group O_h and have the totally symmetric octahedral structure. It was possible to fit all of the observed bands into an identification scheme based on this model. The success of this effort and the high degree of similarity of their spectra to the spectra of the other hexafluorides whose structure is generally accepted as regular octahedral is taken as conclusive evidence in favor of this model. (auth)

3411

APPARATUS FOR THE PYROHYDROLYTIC DETERMINATION OF FLUORIDE AND OTHER HALIDES. C. D. Susano, J. C. White, and J. E. Lee, Jr. (Oak Ridge National Lab., Tenn.). Anal. Chem. 27, 453-4(1955) Mar.

An apparatus for the pyrohydrolytic determination of fluoride and other halides is constructed entirely of nickel and stainless steel rather than platinum and quartz. The apparatus is economical, compact, and easily manipulated. Approximately 5000 determinations were made in 22 months before replacement of the reactor tube was necessary. The tube had been maintained at 1000°C for approximately 3500 hours with daily cooling and reheating. (auth)

3412

MICROCHEMICAL DETECTION OF FLUORIDES. SODIUM FLUOSILICATE CRYSTAL TEST. N. I. Goldstone (Department of Health, New York). Anal. Chem. 27, 464-5(1955) Mar.

A modification in composition of the hanging drop solution in the sodium fluosilicate crystal test for the microchemical detection of fluorides renders the test considerably more sensitive. A detailed procedure is given for detection in a variety of organic and inorganic substances. The test is applied to distinguish between inorganic fluorides and monofluoroacetic acid. (auth)

3413

THERMODYNAMIC PROPERTIES OF NITROGEN TRIFLUORIDE FROM 12°K TO ITS BOILING POINT. THE ENTROPY FROM MOLECULAR AND SPECTROSCOPIC DATA. Louis Pierce and E. L. Pace (Western Reserve Univ., Cleveland, Ohio). J. Chem. Phys. 23, 551-5(1955) Mar.

The heat capacity of nitrogen trifluoride has been measured from 12 to 144°K. The heat of the transition at 56.62°K was found to be 361.8 cal/mole. The heat of fusion at the triple point temperature, 66.37°K, was found to be 95.1 cal/mole. The heat of vaporization at the normal boiling point, 144.15°K, was found to be 2769 cal/mole. The vapor pressure has been measured, and the data are closely represented by the equation $\log_{10} P_{mm} = -673.5828/T + 1.869858 \log_{10} T - 0.00783355T + 4.64615$. The entropy of nitrogen trifluoride gas has been calculated from the calorimetric data and the third law of thermodynamics to be 54.50 cal/deg/mole at 144.15°K. This value agrees very well with the value 54.61 calculated from spectroscopic data and structural parameters which include a pyramidal model for the molecule. (auth)

3414

GROWTH OF LEAD FLUORIDE CRYSTALS FROM THE MELT. D. A. Jones (Univ. of Aberdeen). Proc. Phys. Soc. (London) B68, 165-70(1955) Mar.

The application of Stockbarger's technique to the growth of PbF_2 crystals is described. The melting point of PbF_2 was found to be 822 ± 2°C, and owing to its fairly high vapor pressure at this temperature, the crystals were grown in an atmosphere of oxygen-free nitrogen at a pressure of 2 to 10 mm of mercury. The crystal structure was found to be of the fluorite type, and the lattice constant 5.942 ± 0.001 A at 18°C. Refractive indices are given for various wavelengths in the visible spectrum. The transmission limits, defined as the wavelength at which a specimen of thickness 1 cm absorbs 50% of the incident radiation, are 11.6μ and 2800 A. (auth)

3415

THE ELECTRICAL CONDUCTIVITIES OF PHOSPHORUS AND ANTIMONY TRIFLUORIDES. A. A. Woolf (Univ. of Manchester, England). J. Chem. Soc. (London), 279-80(1955) Jan.

3416

FLUOROSULPHONIC ACID. PART II. IONIZATION IN THE ANHYDROUS SOLVENT AND THE FORMATION OF COMPLEX FLUORIDES. A. A. Woolf (Univ. of Manchester, England). J. Chem. Soc. (London), 433-43(1955) Feb.

The preparation of complex fluorides, by means of solvents, between component fluorides close together in the periodic classification is discussed. Fluosulphonic acid is considered as a possible solvent. Its main self-ionization, which gives rise to a conductivity between that of anhydrous hydrofluoric and sulphuric acids, is to a solvated proton and the fluosulphonate ion. The ions HSO_3^+, H_2F^+, and $S_2O_6F^-$ are considered to be present in negligible amounts. Fluorides soluble in fluosulphonic acid enhance the conductivity. The alkali fluorides, which form fluosulphonates by elimination of hydrogen fluoride, are the bases in this system. Antimony pentafluoride, which contains an antimony anion in fluosulphonic acid solution, is believed to form hexafluoantimonic acid by elimination of sulphur trioxide. This is regarded as an acid and can be neutralized with potassium fluosulphonate solution to give a conductometric minimum at approximately equimolecular proportions. Solutions of other fluorides are then classified as acids or bases with reference to potassium fluosulphonate or antimony pentafluoride in conductometric titrations. AuF_3, TaF_5, and PtF_4, are acids: AsF_3, SbF_3, BrF_3 and IF_5 are bases. The proton acid $HClO_4$ appears not to behave as an acid in the fluosulphonic acid system. Organic compounds can function as bases, and both pyridine and nitrobenzene have been titrated with antimony pentafluoride. (auth)

3417

ORGANOMETALLIC AND ORGANOMETALLOIDAL FLUORINE COMPOUNDS. PART XII. BISTRIFLUOROMETHYLPHOSPHINIC ACID AND RELATED PHOSPHORUS OXYACIDS. H. J. Emeléus, R. N. Haszeldine, and Ram Chand Paul (Univ. Chemical Lab., Cambridge, England). J. Chem. Soc. (London), 563-74(1955) Feb.

Bistrifluoromethylphosphinic acid, $(CF_3)_2PO{\cdot}OH$, is conveniently prepared by hydrolysis of $(CF_3)_3PCl_2$ or $(CF_3)_2PCl_3$. It is the strongest acid of phosphorus ($K > 10^{-1}$), and conductivity measurements in acetic acid solution show it to be one of the strongest known acids: the order of decreasing strength, with approximate relative strengths shown in parentheses, is $HClO_4$ (360) > $(CF_3)_2PO{\cdot}OH$ (250) > HBr (180) > H_2SO_4 (32) > $CF_3{\cdot}PO(OH)_2$, HCl (9) > $(CF_3)_2AsO{\cdot}OH$ (3.5) > $CF_3{\cdot}AsO(OH)_2$ (2.5) > $CF_3{\cdot}CO_2H$, HNO_3, $C_3F_7{\cdot}CO_2H$ (1). Trifluoromethylphosphonous acid disproportionates in concentrated aqueous solution to yield trifluoromethylphosphine and trifluoromethylphosphonic acid, and the anhydrous acid cannot be isolated. The phosphonous acid has weak reducing properties and is moderately strong ($K = 9.8 \times 10^{-2}$). Infrared spectroscopic studies of the P:O bond in trifluoromethylphosphorus compounds are included. (auth)

3418

THE PREPARATION OF TRISTRIFLUOROMETHYLPHOSPHINE OXIDE. Ram Chand Paul (Univ. Chemical Lab., Cambridge, England). J. Chem. Soc. (London), 574-5(1955) Feb.

3419

THE REACTION BETWEEN TELLURIUM AND DICHLORODIFLUOROMETHANE. E. E. Aynsley and R. H. Watson (King's Coll., Newcastle-on-Tyne, England). J. Chem. Soc. (London), 576-7(1955) Feb.

LABORATORIES AND EQUIPMENT

3420 OSR-TN-55-49

Purdue Univ.

LABORATORY VACUUM FURNACE. A. S. Yue, Purdue Univ. and A. G. Guy, Purdue Univ. School of Chemical and Metallurgical Engineering. Jan. 29, 1955. 6p. Contract AF18(600)-310, Report No. 1.

A laboratory vacuum furnace that was designed not only for diffusion experiments but also for general laboratory purposes is described. Its design features and operating characteristics are given. (C.W.H.)

3421 AERE-Lib/Trans-508

THE USE OF ELECTRO-GRAPHITE AND HARD-BURNED COAL IN THE CONSTRUCTION OF CHEMICAL APPARATUS. (Discussion meeting in Meitingen, July 2, 1954, [with discussions by E. Kolbe, R. Söhngen, and H. Krautmann]). Translated by J. B. Sykes from Chem. Ing. Tech. 26, 572(1954). 3p.

Topics discussed at this conference included: the use of electrographite and hard-burned coal in the construction of corrosion-resistant chemical apparatus, the physical and chemical properties of electrographite and hard-burned coal, and details of construction and performance of graphite heat exchangers. (C.H.)

RADIATION CHEMISTRY

3422

CHEMICAL EFFECTS IN FISSION PRODUCT RECOIL. G. N. Walton and I. F. Croall (Atomic Energy Research Establishment, Harwell, Berks, England). J. Inorg. and Nuclear Chem. 1, 149-58(1955) Mar.

Some measurements of I^{131} arising after fission recoil from uranium oxide particles into a surrounding medium of solid potassium iodate show that: the fraction of recoils stopping in the iodate phase increases as the relative amount of iodate to oxide increases; the amount of chemical decomposition in the iodate phase is proportional to the number of fission recoils stopping in the iodate phase and the "G" factor under the conditions in question lies between 2 and 6 molecules of iodate reduced per 100 ev of recoil energy absorbed; the specific activity of the reduced forms of iodine (I_2, I^-) remains fairly constant, whatever the extent of fission, and is always higher than the specific activity of the oxidized form (IO_3^-). Approximately 90 per cent of the I^{131} is retained in the oxidized form. (auth)

3423

PARAMAGNETIC SPECIES IN GAMMA-IRRADIATED ICE. Max S. Matheson and Bernard Smaller (Argonne National Lab., Lemont, Ill.) J. Chem. Phys. 23, 521-8(1955) Mar.

The paramagnetic resonance spectra of H_2O and D_2O ice irradiated at 77°K have been examined. The absorbing species have been identified as H and OH (or D and OD), a significant result for the radiation chemistry of aqueous solutions. The yield of radical pairs/100 ev is about 0.14. The hyperfine splittings of the H doublet and D triplet are a factor of 16 less than are observed in the gas phase. This result is attributed to the effect of the solid on the electronic state of the H or D atoms. The spectra of H_2O_2 in H_2O and D_2O_2 in D_2O irradiated at 77°K support the identification of OH (or OD) absorption. In annealing experiments the H and OH disappear near 115°K. Results on solid ammonia and solid formic acid irradiated at 77°K are also described. (auth)

3424

EFFECT OF PILE IRRADIATION ON SODIUM CHLORATE. L. J. Sharman and K. J. McCallum (Univ. of Saskatchewan, Saskatoon, Canada). J. Chem. Phys. 23, 597(1955) Mar.

The chemical effects following the $Cl^{35}(n,\gamma)Cl^{36}$ reaction in crystalline sodium chlorate were investigated. Because of the long half life of Cl^{36} it was necessary to carry out the irradiation using a high flux of thermal neutrons. After irradiation, the samples were allowed to stand for six months and then were analyzed chemically to identify the substances present. Results indicate that considerable decomposition of the sodium chlorate takes place with a net loss of oxygen. (C.W.H.)

RADIATION EFFECTS

3425

EFFECT OF VARIATIONS IN SOURCE INTENSITY ON THE ALPHA-INDUCED DECOMPOSITION OF AMMONIA. Benjamin P. Burtt and Theodore Baurer (Syracuse Univ., N. Y.). J. Chem. Phys. 23, 466-70(1955) Mar.

The ion yield in the α-induced decomposition of gaseous ammonia is found to increase slightly with the irradiation intensity, both in the presence and absence of electric fields. This is true for ammonia pressures of both 20 and 50 cm, at room temperature. Even a weak electric field increases the ion yield at 50 cm pressure. There is no evidence at 20 or 50 cm pressure of initiation of the reaction by ion recombination. Possible mechanisms are suggested. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

3426

ORDERED INTERMEDIATE PHASES IN THE SYSTEM $CeO_2-Ce_2O_3$. D. J. M. Bevan (Atomic Energy Research Establishment, Harwell, Berks, England). J. Inorg. and Nuclear Chem. 1, 49-59(1955) Mar.

The system $CeO_2-Ce_2O_3$ has been investigated over its entire range of composition. CeO_2 was reduced in hydrogen to varying degrees and the products examined by means of x-ray diffraction techniques to determine the phase relationships. The results indicate the formation of a number of ordered phases: $Ce_{32}O_{58}$, $Ce_{32}O_{57}$, $Ce_{18}O_{31}$ (?) having a rhombohedral structure, and a phase having the type-C rare-earth structure with a composition range extending between the approximate limits $Ce_{32}O_{53}$ and $Ce_{32}O_{54}$. The solid solution range of the $\alpha(CeO_2)$-phase is found to be very narrow. The type-A rare-earth (Ce_2O_3)-phase appears to have a solid solution range between $CeO_{1.50}$ and $CeO_{1.53}$. (auth)

3427

THE RAPID SEPARATION OF RARE-EARTH FISSION PRODUCTS BY CATION EXCHANGE, USING LACTIC-ACID ELUANT. J. G. Cuninghame, M. L. Sizeland, and H. H. Willis (Atomic Energy Research Establishment, Harwell, Berks, England) and J. Eakins and E. R. Mercer (Atomic Weapons Research Establishment, Aldermaston, Berks, England). J. Inorg. and Nuclear Chem. 1, 163-4(1955) Mar.

A procedure for the rapid separation of short-lived fission products by cation exchange has been developed. A satisfactory separation of a mixture containing Y, Eu, Sm, Pm, Nd, and Pr was obtained in less than four hours. (C.W.H.)

3428

THE SEPARATION OF THE LANTHANONS WITH THE AID OF ETHYLENEDIAMINETETRAACETIC ACID ("ENTA ACID"). PART V. THE SOLUBILITIES OF SOME ALKALI LANTHANON ENTA SALTS. J. K. Marsh (Dyson Perrins Lab., Oxford, England). J. Chem. Soc. (London), 451-2(1955) Feb.

Sodium lanthanon enta salts show a range of solubilities increasing by up to 18-fold from gadolinium to erbium. The behavior of the potassium salts is similar but the range is smaller. Both series are readily crystallized. In the cerium group the solubility differences are small. (auth)

SEPARATION PROCEDURES

3429 AERE-Lib/Trans-476

THE SEPARATION OF MATERIALS IN PRECISION DISTILLATION COLUMNS. W. Kuhn, P. Baertschi, and M. Thurkauf. Translated by F. Hudswell from Chimia Switz. 8, 109-22(1954). 50p.

A discussion of various mathematical implications of fractional distillation is presented. Results are reported of separations carried out by columns designed for optimum separation. (C.W.H.)

3430

THE EXTRACTION AND PURIFICATION OF SCANDIUM. R. C. Vickery (Commonwealth Fertilisers and Chemicals Ltd., Melbourne, Australia). J. Chem. Soc. (London), 245-51(1955) Jan.

The extraction of scandium from wolframite residues and thortveitite is described. Final purification is effected by ion-exchange techniques which are approached by phase-distribution and acid-base-titration data. Hydrazine-NN'-diacetate solutions rapidly remove scandium from mixtures with the rare earths and thorium, and the separation thus achieved is superior to that with citrate or ethylenediamine-NNN'N'-tetra-acetate solutions. (auth)

3431

CHLORINATION OF TRAVANCORE MONAZITE. PART II. SEPARATION OF THORIA FROM RARE EARTHS WITH UROTROPINE. B. Sarma and J. Gupta (National Chemical Lab. of India, Poona). J. Sci. Ind. Research (India) 14B, 82-4(1955) Feb.

Thoria is quantitatively precipitated from its nitrate and chloride solutions and separated from an admixture with a twenty-fold excess of the rare earths by hydrolytic precipitation at pH 4 in a medium of urotropine and hydrochloric acid. The method has been employed in the preparation of pure thoria from chlorinated Travancore monazite. (auth)

SORPTION PHENOMENA

3432 AERE-Lib/Trans-455

EXPERIMENTS ON ADSORPTION ON POWDER METALS. PART I. Hans v[on] Euler and A. H. Hedelius. Translated by E. R. Hollely from Arkiv Kemi Mineral. Geol. 7, 1-15(1920). 10p.

Experimental data are presented on the adsorption of potassium chloride and silver nitrate on powdered silver. (C.W.H.)

3433 TT-509

QUANTUM THEORIES OF ADSORPTION. (Kvantovye Teorii Adsorbtsii). B. L. Bonch-Bruevich. Translated by R. B. Mudge from Uspekhi Fiz. Nauk 40, 369-406(1950). 41p.

Problems in the theory of adsorption as one of the forms of interaction of a molecule of gas with the surface of a solid are examined from the view point of quantum mechanics. Topics discussed include the theory of forces of physi-

cal adsorption; adsorption on ionic crystals; adsorption on metals; the theory of adsorption kinetics; adsorption coefficients; the life of a molecule on the surface and probability of adsorption when a molecule collides with the surface; selective adsorption and surface migration; and electron phenomena during adsorption. 55 references. (C.H.)

SPECTROSCOPY

3434 AD-44632

Sterling Chemistry Lab., Yale Univ.

TECHNICAL REPORT NO. 1. I. THE INFRARED SPECTRA AND STRUCTURE OF NaOH and NaOD. William R. Busing. II. THE RAMAN SPECTRA OF NaOH, LiOH, AND LiOH·H_2O. Betty A. Phillips and William R. Busing. III. THE INFRARED SPECTRA OF KOH AND HYDRATED KOH. William R. Busing. Sept. 1954. 38p. Contract AF18(600)-859.

The infrared spectra of NaOH, NaOD, and mixtures of these compounds were studied at room and liquid-air temperatures. The results at room temperature, taken together with the Raman spectrum of NaOH, are consistent with the x-ray structure and postulated H positions. At liquid-air temperature the spectrum of NaOD showed unexpected complexity. The Raman frequencies of the hydroxide stretching vibrations were measured for NaOH, LiOH, and LiOH·H_2O at room temperature. The results, taken together with the corresponding infrared frequencies, are consistent with the x-ray structures of these compounds. The infrared spectra of KOH and hydrated KOH were studied at room and liquid-air temperatures. (J.A.G.)

3435

APPLICATIONS OF CURVED-CRYSTAL X-RAY SPECTROMETERS. MICROANALYSIS AND SIMULTANEOUS ANALYSIS. L. S. Birks and E. J. Brooks (U. S. Naval Research Lab., Washington, D. C.). Anal. Chem. 27, 437-40 (1955) Mar.

Curved, reflection-type, focusing crystals allow fluorescent x-ray spectroscopy to be applied to analysis of microgram quantities of specimen material. The intensity, resolution, and line-background ratio from a 1-mg specimen on a curved-crystal spectrometer were found to be as good as those from a 10-gram specimen on a commercial flat-crystal spectrometer. Parts per million of niobium, hafnium, tantalum, thorium, and uranium in iron were measured by extracting these elements from 10 grams of iron, the residue containing 5 to 20 mg of each of the five elements. Standard deviations for these measurements were of the order of 13% of the amount present. Curved crystals also simplify the instrumentation for simultaneous analysis of several elements in a specimen. An example is shown for the analysis of chromium, nickel, and molybdenum in steel with a very compact arrangement of fixed detectors and curved crystals. (auth)

URANIUM AND URANIUM COMPOUNDS

3436

HIGH FREQUENCY TITRATIONS INVOLVING CHELATION WITH ETHYLENEDIAMINETETRAACETIC ACID. III. DETERMINATION OF URANYL ION. Reinosuke Hara and Philip W. West (Louisiana State Univ., Baton Rouge). Anal. Chim. Acta 12, 285-91(1955) Mar. (In English)

A high frequency titration employing tri-sodium ethylenediaminetetraacetate is suggested for the determination of uranyl ion. It has been shown that for the pH range of 3.5 to 4.0 ethylenediaminetetraacetic acid reacts with uranyl ion to form a stable salt. The reacting ratio was found to be 2 : 1 (metal to addendum) which is in contrast to the usual reacting ratio of 1 : 1 obtained with ethylenediaminetetraacetic acid and other heavy metals. The chelate obtained with uranyl ion is probably a pseudo salt. (auth)

3437

CRYSTAL STRUCTURE OF RUTHERFORDINE, UO_2CO_3. C. L. Christ, Joan R. Clark, and H. T. Evans, Jr. (U. S. Geological Survey, Washington, D. C.). Science 121, 472-3 (1955) Apr. 1.

Data are presented on the physical properties and crystal structure of UO_2CO_3. (C.H.)

3438

HYDROLYSIS OF URANYL IONS AND THE FORMATION OF SODIUM URANATES. J. Sutton (Commissariat à l'Energie Atomique, Paris). J. Inorg. and Nuclear Chem. 1, 68-74(1955) Mar. (In French)

The compositions of the uranates precipitated by mixing solutions of sodium hydroxide and uranyl chloride have been investigated by the method of residues. The results indicate that two uranates are formed, $Na_2U_{16}O_{49}$ (yellow) and $Na_2U_7O_{22}$ (orange). The former yields yellow $Na_2U_7O_{22}$ on washing with water. Reasons for the disagreement between these and previous results are discussed. (auth)

ENGINEERING

3439 DTMB-863

David W. Taylor Model Basin

BIBLIOGRAPHY ON SHELLS AND SHELL-LIKE STRUCTURES. William A. Nash. Nov. 1954. 75p.

Approximately 1450 papers and books pertinent to experimental and theoretical work on shells and shell-like structures are listed in this compilation. The entries are listed in chronological order, and both author and subject indexes of the papers are included. The listing is believed to be current through December 1953. (auth)

3440

NICKEL DIFFUSION LEAK FOR HYDROGEN. E. R. Harrison and L. C. W. Hobbis (Atomic Energy Research Establishment, Harwell, Berks, England). Rev. Sci. Instr. 26, 305-6(1955) Mar.

A comparison is presented of relative merits of Ni and Pd diffusion leaks for regulating a supply of purified H_2. Constructional details are then given for a Ni leak which proved satisfactory in furnishing the desired amount of H_2 to a high-intensity proton ion source. (L.M.T.)

3441

CHARTS FOR PRESSURE VESSEL DESIGN. C. J. Major. Chem. Eng. 62, No. 4, 172-5(1955) Apr.

HEAT TRANSFER AND FLUID FLOW

3442 AECU-2997

RAND Corp.

ON THE STABILITY OF FLUID FLOWS WITH SPHERICAL SYMMETRY. M[ilton] S. Plesset. Apr. 15, 1953. 10p. [For Radiation Lab.], Univ. of Calif., Berkeley. Subcontract [to W-7405-eng-48]. (P-395-AEC)

The conditions for the stability or instability of the

interface between two immiscible incompressible fluids in radial motion are deduced. The stability conditions for the interface of two fluids in plane motion do not apply to spherical flows without significant modifications. (auth)

3443 AERE-X/R-1381

Atomic Energy Research Establishment, Harwell, Berks (England)

A REPORT ON THE PROCEEDINGS OF THE LIQUID METAL UTILIZATION CONFERENCE HELD IN ABINGDON, MAY 16, 1953. C. G. Banister, C. J. Heming, N. F. Goodway, and B. L. Tozer, eds. Mar. 26, 1954. 130p.

Papers on the following are included: design and operation of an apparatus for handling liquid Na and similar fluids; electromagnetic pumping of liquid metals, including reasons for adoption over mechanical forms, basic principles of operation, design of a small single-phase pump capable of handling Na of 200 to 500 kev, and a few notes regarding the large-scale pumping of liquid metals; use of liquid metals for high-temperature heat transfer, including properties, advantages as high-temperature media, design of heat exchangers, and application of liquid metals to nuclear power production and gas turbines; heat-transfer experiments with liquid Na; design and construction of a Na–steam superheater test plant; a study of Na-heated steam generating plant; and the application of liquid metals to reheating in a steam turbine plant. (J.A.G.)

3444 ISC-552

Ames Lab.

THE THEORY OF VIBRATING JETS IN LIQUIDS OF VARIABLE SURFACE TENSIONS. Robert S. Hansen. [Dec. 6, 1954]. 15p. Contract [W-7405-eng-82].

The theory of jet oscillations in a liquid of time-dependent surface tension has been analyzed. To the extent that the surface tension change can be represented as linear over a single wave length, the wave length is approximately that given by the non-time-dependent equations with surface tension constant at the mean value over the wave length. A high-frequency low-amplitude oscillation will be superimposed on the principal jet motion, which should, however, present negligible complications under usual experimental conditions. (auth)

3445 K-1187

Carbide and Carbon Chemicals Co. (K-25)

VELOCITY AND PRESSURE DISTRIBUTIONS IN TURBULENT PIPE FLOW WITH UNIFORM WALL SUCTION. Harold L. Weissberg. Mar. 29, 1955. 243p. Contract W-7405-eng-26.

The effect of wall suction on the turbulent flow of air in a porous pipe was investigated for various flow and suction rates. Radial distributions of time averaged axial velocities and of the axial component of the turbulent velocity fluctuations were measured at various distances from the pipe entrance using hot wire anemometry techniques. Distributions of pressure on the axis of the pipe were also observed. Complete tables of data are given in appendices, and several typical examples of the observed effects of wall suction on the velocity and pressure distributions are presented graphically for discussion. Increasing wall suction was observed to lower the radial component of the velocity gradient over most of the pipe cross section and to increase it in the vicinity of the wall. Turbulence levels were lowered by the suction over the entire cross section. Pressure drops in the axial direction were also lowered, and the pressure was observed to rise in the direction of flow for sufficiently large suction rates. Some of these observations are discussed in the light of a momentum equation derived from the time averaged equations of motion. (auth)

3446 UCRL-4459

Radiation Lab., Univ. of Calif., Livermore

EFFECT OF A DENSITY GRADIENT ON TAYLOR INSTABILITY. R. LeLevier, G. J. Lasher, and F. Bjorklund. Feb. 21, 1955. 4p. Contract W-7405-eng-48.

Taylor's derivation of the instability of an accelerated surface of density discontinuity is extended to the case in which the density has a smooth transition. (auth)

3447 AEC-tr-2103

CONCERNING THE GENERAL HEAT TRANSFER LAW FOR TURBULENT FLOW IN PIPES AND THE MEANING OF THE CHARACTERISTIC NUMBERS. (Über Das Allgemeine Wärmeübergangsgesetz Der Turbulent Rohrströmung Und Den Sinn Der Kennzahlen). E. Hofmann. Translated by Louis Bernath and Anne Sandel from Forsch. Gebiete Ingenieurw. 20B, 81-93(1954). 30p.

3448 AERE-Lib/Trans-473

ON ABSOLUTE RATES OF DISSOLVING. N. Ya. Buben and D. A. Frank-Kamenetskii. Translated by V. Beak from Zhur. Fiz. Khim. 20, 225-38(1946). 15p.

An investigation was made of the kinetics of dissolution under conditions of turbulent flow. Data are included from studies of the dissolution of a Cu tube in nitric acid and in ferric chloride and the dissolution of gypsum in water, in acids, and in the presence of dyes. Data are included on the effects of rotation of the dissolving solid in the liquid and variation in liquid temperature on the rate of dissolution. The effect of stirring with an agitator on rate of dissolution is discussed. Experimental data are compared with published results from other investigators. A theoretical analysis is presented of the dependence of Margulis' criterion upon Reynolds' and Prandtl's criteria for the internal problem. (C.H.)

3449 AERE-Lib/Trans-499

ON THE INTERRELATION BETWEEN THE HYDRODYNAMICS OF STEAM–WATER MIXTURES, THE TEMPERATURE DISTRIBUTION IN A METAL AND THE DEPOSITION OF EASILY SOLUBLE SALTS IN HORIZONTAL STEAM-GENERATING PIPES. M. A. Styrikovich, Z. L. Miropolskii, and N. M. Anakin. Translated by J. B. Sykes from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, 432-40(1953). 10p.

Several series of experiments have been performed in a closed circulating system including heated vertical and horizontal portions of steam-generating pipes of various diameters. It was found that deposition of NaCl and Na_2SO_4 took place in the horizontal parts of boiler pipes when the temperatures of the upper part of the pipe wall were higher than those of the lower part. The probability of the occurrence of deposition increases with pressure. (M.P.G.)

3450 NAA-AL-684

THE LAMINAR BOUNDARY LAYER IN GASES. Luigi Crocco. Translated by I. Hodes and J. Castelfranco from Monografie Scientifiche di Aeronautica, No. 3, Dec. 1946. 141p. (CF-1038)

Results are reported from an investigation in the range of transonic and supersonic velocities of the phenomena which appear in experimental studies on the laminar boundary layer clinging to bodies immersed in moving fluids. The

procedure used for transforming the equations of the boundary layer to make them more amenable to practical integration is described. These equations introduce as unknown functions the viscous stress and the enthalpy, which are the two quantities of most interest in the study of the interactions between the stream and the immersed body. The transformed equations are applied to the case of the straight wall. Results are compared with those reported by other investigators. Using the formula of Sutherland, the law of variation of viscosity for real gases is discussed and the equations for the Prandtl number of dry air are integrated. The distribution of the viscous stress, and therefore the friction on the wall, are determined, as well as the distribution of enthalpy over a large range of variation of the value of the mechanical and thermal forces operative. Interesting formulae and laws for the quantities that are related to the exchange of heat between the fluid and the wall are included. (C.H.)

3451

ANALOG METHODS FOR STUDY OF TRANSIENT HEAT FLOW IN SOLIDS WITH TEMPERATURE-DEPENDENT THERMAL PROPERTIES. Norman E. Friedmann (Univ. of California, Los Angeles). J. Appl. Phys. 26, 129-30(1955) Jan.

Methods are described for using nonlinear semiconductors in analog computers to obtain the solution of nonlinear heat transfer problems. Particular attention is given to avoiding the wide use of costly function generators and multiplying equipment, or mechanically variable circuit elements. (K.S.)

MATERIALS TESTING

3452 PA-TR-2060

Picatinny Arsenal

SURVEY OF THE METHODS USED TO DETERMINE THE DYNAMIC MECHANICAL PROPERTIES OF POLYMERS. Oscar R. Abolafia. Sept. 1954. 41p.

A literature survey was conducted of the best methods used in determining the dynamic mechanical behavior of polymers. A general theoretical treatment of the information is given by classifying the test methods so that they may be more conveniently discussed and compared. The best methods are grouped into three major divisions — attenuation methods, resonance methods, and direct stress-strain methods. Each division is further broken down into sub-groups. Brief comment on the various test methods is provided dealing with ease of operation, degree of accuracy and precision, and cost of instrumentation. 52 references. (auth)

3453 TAM-79

Illinois Univ.

INVESTIGATION OF THE BEHAVIOR OF OVERSTRAINED THICK-WALLED CYLINDERS. TECHNICAL REPORT NO. 2. THE OVERSTRAINING OF THICK-WALLED MILD STEEL CYLINDERS. M. C. Steele and L. C. Eichberger. Feb. 1955. 72p. Contract DA-11-022-ORD-1527.

Experimental results are presented on the behavior of three mild steel cylinders (6 in. O.D. × 3 in. I.D. × 8 in. long) overstrained by internal pressure. Particular attention is made to the mechanism of yielding and the variation and character of strains measured at the bore and outside surfaces. Yield initiates and propagates into the cylinder walls by the formation of a limited number of Lueders' lines. Initial yield is caused by a maximum shear stress higher than that necessary to propagate yield. Lueders' line patterns (recorded on one end face) are defined by two groupings situated approximately at opposite ends of a diameter. They follow closely the maximum shear stress trajectories. The nonhomogeneous mechanism of yielding is clearly shown up by variations in strain circumferentially. Fully yielded pressures are some 10 to 14 percent lower than those predicted by theories when yield stresses from tension tests conducted at normal rates of loading are used. Axial strains, to a first approximation, are elastic, which is in agreement with a theory due to Koiter but in marked disagreement with Thomas' theory. Small differences between experimental and theoretical shapes of pressure-circumferential strain curves are attributed to the non-homogeneous mechanism of yielding. Creep or slow yield is a feature of the tests. Lueders' lines require time, 15 to 30 minutes, to reach an equilibrium state at a specific pressure stage. Corresponding creep is shown up in the circumferential strains. (auth)

VACUUM SYSTEMS

3454 AERE-Lib/Trans-485

LEAK DETECTOR INVOLVING THE HALOGEN METHOD FOR HIGH VACUUM TUBES. A. Weber. Translated by R. J. Richardson from Glas-u. Hochvakuum-Tech. 2, 259-62(1953). 5p.

The ionic emission of a hot platinum anode increases when a halogen-containing gas impinges on it. Use has been made of this "halogen effect" in a sensitive leak detector for high vacuum systems. The instrument is described, and a circuit diagram is included. (M.P.G.)

MINERALOGY, METALLURGY, AND CERAMICS

3455 AD-12978

Horizons, Inc.

INVESTIGATION OF A NEW METHOD FOR THE DETERMINATION OF THE COEFFICIENTS OF SURFACE DIFFUSION OF METALS. Samuel J. Strindberg and F. C. Wagner. June 2, 1953. 19p. Contract AF-18(600)-644.

The interferometric method described for determining the surface diffusion coefficients has severe limitations, but attempts will be made to further refine the techniques. (L.M.T.)

3456

INVESTIGATION OF ACCIDENT INVOLVING TITANIUM AND RED FUMING NITRIC ACID, DECEMBER 29, 1953. P. M. Ambrose, J. C. Barrett, R. W. Huber, David Schlain, and V. C. Petersen. U. S. Bur. Mines Circ. 7711, Mar., 1955. 34p.

This report describes an accident which took place in the Chemical Corrosion Laboratory at the College Park, Md., Station of the Federal Bureau of Mines. The accident occurred while Walter L. Acherman, chemist, was performing a routine manipulation during a corrosion experiment involving commercially pure titanium and red-fuming nitric acid. There was a sudden and very violent reaction, and a large quantity of acid was thrown in the face and over the body of Acherman, causing serious injury. L. B. Golden, chief of the Chemical Corrosion Section, was exposed to

nitric acid fumes during the ensuing rescue and first-aid operations and died on January 25, 1954. According to the medical report, the direct cause of Mr. Golden's death was pulmonary edema and confluent bronchopneumonia; the contributary cause was inhalation of fumes from red fuming nitric acid. Data on the behavior of commercially pure Ti in red-fuming nitric acid are summarized. (auth)

CERAMICS AND REFRACTORIES

3457 WADC-TR-54-212
Massachusetts Inst. of Tech.
[CERAMIC COMPONENTS FOR AIRCRAFT POWER PLANTS]. STUDIES IN THE SYSTEM NICKEL–TITANIUM –CARBON. Edward R. Stover and John Wulff. Jan. 1954. 20p. Contract AF33(616)-61. (AD-44666)

The Ni–Ti–C system has been studied by metallographic, x-ray, and magnetic examination of arc-melted and annealed alloys. Each of the Ni–Ti intermetallics forms a two-phase field with TiC. The solidus of the nickel-rich portion shows a quasi-binary eutectic at 1307°C running between a nickel solid solution containing 9 at. % Ti and TiC having close to 50 at. % carbon. Ternary eutectics at 1270 and 1295°C form with graphite and $TiNi_3$, respectively. The binary eutectics nickel–graphite and nickel–$TiNi_3$ were found to be at about 1328 and 1304°C. A pure Ni–TiC cermet binder should contain about 10 wt. % TiC when liquid, and this solubility should drop to 3.6 wt. % at 1270°C and about 2% at 870°C. Graphite may be precipitated from the binder immediately below the solidus, and the binder may be slightly supersaturated in carbon by rapid cooling. Oxygen contamination inhibits solution of TiC by the liquid binder, and must be prevented in sintering TiC–Ni cermets. (auth)

CORROSION

3458 AECU-3013
Case Inst. of Tech.
HIGH TEMPERATURE SCALING BEHAVIOR OF ZIRCONIUM. FIRST TECHNICAL PROGRESS REPORT [COVERING PERIOD APRIL 1, 1953 TO MARCH 1, 1955]. D. J. Garibotti, H. M. Green, and W. M. Baldwin, Jr. Mar. 15, 1955. 83p. Contract AT(11-1)-258.

The scaling behavior of arc-melted iodide zirconium sheet in air, oxygen, nitrogen, and mixtures of oxygen and nitrogen were studied at elevated temperatures (600 to 1300°C). Zirconium heated in air formed first a black oxide which was superseded by a white scale after times which were dependent on the scaling temperature. No change in scale color was observed during isothermal runs in pure oxygen and in pure nitrogen; however, specimens heated in mixtures of the two gases showed the same color change as in air. X-ray patterns of the black scale formed in air revealed monoclinic and tetragonal ZrO_2 with possibly some lines of ZrN; the white scale consisted of both forms of ZrO_2. Scales formed in pure oxygen were composed of both forms of ZrO_2, while those formed in nitrogen revealed ZrN. Heating zirconium in air below 1050°C caused considerable lateral dimensional increases of the metal. This phenomena did not set in immediately but required a definite time to start. Growth of the metal was also observed in the oxygen plus nitrogen mixtures, but not in the pure gases. During isothermal runs in air up to 1050°C the initial parabolic or cubic rate was followed by a sharply increased scaling rate. The same behavior was observed in oxygen plus nitrogen mixtures but not in the pure gases where a quasi-parabolic rate was observed. The time at which the deviation from the first law occurred was found to be dependent on the composition of the atmosphere. (auth)

3459 EES-040028B
Naval Engineering Experiment Station, Annapolis
CORROSION PROPERTIES OF VARIOUS MATERIALS IN HIGH TEMPERATURE WATERS. C. J. Lancaster. June 22, 1953. 26p. (AD-23384)

Stressed and unstressed types-347 and –310 stainless steels were corrosion-tested in 500°F H_2O containing 300 ppm NaCl. Stressed and unstressed types-347 and –304 stainless steels were static-tested in 500°F boiler feedwater with various concentrations of constituents. Dynamic loop tests were made on various alloys at 10 ft/sec in 500°F H_2O containing 1 to 3 ml/l of O, and dynamic autoclave tests were run on various prestressed alloys in 550°F natural sea water at 10 ft/sec. A 100-hr test in oxygenated (15-35 ml/l) NaCl solution caused some general corrosion in all of the specimens and stress-corrosion cracking in all of the stressed specimens. A 14-day test in degassed NaCl solution produced only slight corrosion and no stress-corrosion cracking. No stress-corrosion cracking was observed after 14-day static tests in various concentrations of boiler feedwater. The corrosion rates of the stainless alloys in the dynamic loop tests were similar to those found in previous studies. Titanium was highly resistant to corrosion in the hydraulic loop, and the 90-10 and 70-30 Cu-Ni alloys had corrosion rates greater than any of the stainless materials. Results of the dynamic autoclave tests indicated that, in addition to type-347 stainless steel, several stainless-steel alloys were susceptible to stress-corrosion damage in sea water. Titanium and Hastelloy C were more resistant to corrosion than the stainless steel alloys. (auth)

3460
A THEORETICAL BASIS FOR A NEW METHOD OF INVESTIGATING CORROSION INHIBITION. James G. Jewell (Gulf Research and Development Co., Pittsburgh). J. Electrochem. Soc. 102, 198-205(1955) Apr.

A theoretical basis is presented for screening cathodic inhibitors by means of a function that may be determined by potential measurements when an external current is imposed across the metal-solution interface. (auth)

GEOLOGY AND MINERALOGY

3461 NYO-6060
Pennsylvania State Univ. Coll. of Mineral Industries
AN INVESTIGATION OF THE MINERALOGY, PETROGRAPHY AND PALEOBOTANY OF URANIUM-BEARING SHALES AND LIGNITES. (SCOPE A—SHALES). THIRD ANNUAL REPORT [FOR] PERIOD OF APRIL 1, 1953 TO MARCH 31, 1954. E[rwin] O. Strahl, E[lena] Camilli, N. M. Short, E[ugene] N. Silverman, L[ois] A. Weiser, H[arold] D. Wright, and T[homas] F. Bates. Mar. 31, 1954. 75p. Contract AT(30-1)-1202.

Mineralogical and petrographic analysis of the Chattanooga formation has resulted in the development of several important techniques, the accumulation of a large amount of quantitative data, and, as a result, a clearer picture of the relationship of uranium with composition and texture as illustrated by a detailed analysis of a core from the Highland Rim area. The techniques include the perfection of nuclear emulsions for use as substrates in the electron

microscope, the application of the spectrophotometer to measure the color of shale samples, and the development of an x-ray method for investigating composition and texture in thin sections. Thin section point counts, alpha-track counts, electron microscope studies of bitumen, and quantitative mineralogical and chemical analyses of a large number of samples have resulted in a mass of data of which the analysis is partially complete. A careful study of sixty samples from thirty five feet of Chattanooga shale has yielded statistically significant correlations between uranium and some of the shale constituents. The correlation is positive with respect to "blackness" of the sample carbon, pyrite, and sulfur, and negative with quartz plus feldspar, clay, and Fe_2O_3. A partial correlation of uranium, pyrite, and carbon shows that, in this core, the correlation of uranium with carbon is better when the effect of pyrite is included than when it is excluded. Since the same relationship holds in the case of uranium with pyrite, including and excluding carbon, it is apparent that the association of carbon and pyrite favors the concentration of uranium. A positive correlation of uranium with the ratio of quartz plus feldspar counted in thin section (>1μ) to total quartz plus feldspar together with the negative correlation of uranium with clay indicate that the black beds which contain more uranium are coarser than the gray beds. (auth)

3462 NYO-6061

Pennsylvania State Univ. Coll. of Mineral Industries
AN INVESTIGATION OF THE MINERALOGY, PETROGRAPHY AND PALEOBOTANY OF URANIUM-BEARING SHALES AND LIGNITES. (SCOPE B — LIGNITES). THIRD ANNUAL REPORT [FOR] PERIOD OF APRIL 1, 1953 TO MARCH 31, 1954. E. F. Koppe, E. S. Erickson, Jr., C. L. Trotter, R. S. Good, W. Spackman, Jr., and T[homas] F. Bates. Mar. 31, 1954. 178p. Contract AT(30-1)-1202.

Objectives of the program were to learn the location of the uranium relative to the discrete organic and/or inorganic constituents of lignites and to elucidate, in some degree, the environmental conditions conducive to the concentrations of uraniferous materials in lignitic sediments. Collections of suitable lignite and clay for these studies were made. Results of the summer field work indicate the lignite occurrences, record the range of materials encountered, and provide a permanent record of the samples available for study. Intensive study of uranium-bearing lignites and associated clay deposits in this program is focused upon three localities in the Slim Buttes area, Harding County, South Dakota; (1) the Mendenhall stripping site, (2) site "SD-1," and (3) site "BM-1." The clay seams associated with the lignite deposits at the Mendenhall stripping site, site "BM-1" and site "SD-1" were studied with a view toward working out the qualitative mineralogy of these beds. The study centered on the finer-grained fractions of the clay seams, in essence, the clay minerals. The methods of study are described briefly. A discussion of the characteristics of the minerals present and their distribution is included. A general qualitative study of the mineralogy of the lignite seams was also carried out. (auth)

3463

A^{40}-K^{40} DATING. G. J. Wasserburg (Univ. of Chicago). Geochim. et Cosmochim. Acta 7, 51-60(1955) Feb.

The A^{40}/K^{40} ratios and the Pb–U ages of various co-existing potassium feldspars and uraninites were determined. It was found that with a branching ratio $\lambda_e/\lambda_\beta = 0.085 \pm 0.005$ and a decay constant $\lambda = 0.55 \times 10^{-9}$/yr, the A^{40}/K^{40} ages could be brought into agreement with the Pb–U ages for samples ranging from 260 to 1860 my. No evidence was found for the loss of argon by diffusion from potassium feldspars. (auth)

3464

THEORETICAL EFFECT OF DIFFUSION ON ISOTOPIC ABUNDANCE RATIOS IN ROCKS AND ASSOCIATED FLUIDS. F. E. Senftle and J. T. Bracken (U. S. Geological Survey, Washington, D. C.). Geochim. et Cosmochim. Acta 7, 61-76 (1955) Feb.

Diffusion is considered as a possible process of isotope fractionation taking place throughout geologic time. Both diffusion in solids and diffusion in liquids are taken as possible mechanisms, the latter being more important. Arguments are presented to show that if significant fractionation takes place within a crystal by outward diffusion under solid-state conditions, enrichment will be evident only in elements of minor concentration. Similar conclusions are inferred for solid-state diffusion across a boundary or for diffusion in liquids. No isotopic enrichment can be expected in relatively large bodies of diffusion transported material. Although the necessary data to confirm these conclusions are scanty, it seems worth while to undertake further work in this direction. (auth)

3465

GLOSSARY OF URANIUM- AND THORIUM-BEARING MINERALS. THIRD EDITION. Judith Weiss Frondel and Michael Fleischer. U. S. Geol. Survey Bull. 1009-F, 1955. pp.169-209. $0.20 (GPO)

The third edition of the glossary of U- and Th- bearing minerals is divided into three sections consisting of minerals that contain U or Th as major constituents, minerals that contain minor amounts of U or Th, and minerals that probably do not contain U or Th but which have been reported to contain impurities or intergrowths of U and Th minerals. (J.E.D.)

3466

RECONNAISSANCE FOR URANIUM-BEARING CARBONACEOUS MATERIALS IN SOUTHERN UTAH. Howard D. Zeller. U. S. Geol. Survey Circ. 349, 1955. 9p.

A reconnaissance investigation for uranium-bearing carbonaceous materials was made in three major areas of southern Utah: Kaiparowits Plateau, Henry Mountains, and Kolob Terrace. No uranium deposits of economic interest were found. A few 1- to 2-foot beds of carbonaceous shale in the Dakota(?) sandstone contain 0.006 to 0.007% uranium. Other carbonaceous sediments that were examined contain 0.002% or less uranium. (auth)

3467

PHOTOGEOLOGIC MAP OF THE ELK RIDGE-14 QUADRANGLE, SAN JUAN COUNTY, UTAH. MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAP I-8. C. F. Miller. Washington, U. S. Geological Survey, 1955. $0.50.

3468

PHOTOGEOLOGIC MAP OF THE STRAIGHT CLIFFS-3 QUADRANGLE, KANE COUNTY, UTAH. MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAP I-13. B. H. Kent. Washington, U. S. Geological Survey, 1955. $0.50.

3469

PHOTOGEOLOGIC MAP OF THE KAIPAROWITS PEAK-9 QUADRANGLE, GARFIELD COUNTY, UTAH. MISCEL-

LANEOUS GEOLOGIC INVESTIGATIONS MAP I-15. J. S. Detterman. Washington, U. S. Geological Survey, 1955. $0.50.

3470

PRELIMINARY GEOLOGIC MAP OF THE GYPSUM GAP QUADRANGLE, COLORADO. MINERAL INVESTIGATIONS FIELD STUDIES MAP MF-19. Fred W. Cater, Jr. Washington, U. S. Geological Survey, 1954. $0.25.

3471

SPECTROGRAPHIC DETERMINATION OF CONTAMINATION OF ROCK SAMPLES AFTER GRINDING WITH ALUMINA CERAMIC. P. R. Barnett, W. P. Huleatt, L. F. Rader, and A. T. Myers (U. S. Geological Survey, Denver, Colo.). Am. J. Sci. 253, 121-4(1955) Feb.

Contamination of rock samples pulverized between experimental ceramic disks is determined and found to be almost negligible when compared to contamination resulting when the samples are ground with steel disks, particularly with regard to iron and alloying elements of steel. A method of mounting the disks on a conventional grinder is described. (auth)

3472

U. S. GEOLOGICAL SURVEY RADIOCARBON DATES. II. Meyer Rubin and Hans E. Suess (U. S. Geological Survey, Washington, D. C.). Science 121, 481-8(1955) Apr. 8.

Radiocarbon dates are presented for an additional number of geological samples collected from various localities. Part I of this paper appeared in Science 120, 467-73(1954) Sept. 24. (C.W.H.)

3473

ISOLATION OF ORGANIC CARBON FROM BONES FOR C^{14} DATING. Irving May (U. S. Geological Survey, Washington, D. C.). Science 121, 508-9(1955) Apr. 8.

A method is presented for the isolation of organic carbon from bones for age determination by C^{14} techniques. This method consisted of pyrolysis of the bones in a nitrogen atmosphere, followed by acid solution of the mineral matter. The residual carbon was collected by centrifuging. (C.W.H.)

3474

AGE MEASUREMENTS ON A PEGMATITIC MICA FROM THE RHODESIAN SHIELD. G. D. L. Schreiner, R. T. Jamieson, and B. F. J. Schonland (Univ. of the Witwatersrand, Johannesburg). Nature 175, 464(1955) Mar. 12.

The method of separating and sampling materials for age determinations by the Rb^{87}–Sr^{87} method involves a possible source of error. As an example, a sample containing three sharply differentiated types of mica is described. A wide variation in concentrations of Rb^{87} and Sr^{87} was found in the three subsamples. If the necessary determinations of Rb^{87} and Sr^{87} content and isotopic abundances had not been made on the same separated subsamples, the age results might have been very much in error. (M.P.G.)

METALS AND METALLURGY

3475 AD-10555

Armour Research Foundation

INVESTIGATION OF THE METALLURGICAL CHARACTERISTICS OF THE 36% ALUMINUM TITANIUM-BASE ALLOY. QUARTERLY REPORT NO. 3 [FOR] DECEMBER 1, 1952 TO MARCH 1, 1953. J. B. McAndrew and H. D. Kessler. Apr. 8, 1953. 21p. Contract AF33[616]-196.

Modification of a cylindrical graphite mold permitted the casting of sound Ti–36% Al ingots suitable for machining to specimens of 0.25-in. gage diameter. The quality of large arc-melted ingots was improved by using a master alloy of about 44% Al. An iodide Ti–34% Al–4.4% Mn alloy was reduced 30% in thickness when compressed at 110,000 psi at 1330 to 1280°C. The tensile strength of cast Ti–36% Al material, treated for 20 min at 1250°C and oil-quenched, was about 45,000 psi at room temperature. A pressed, high-purity alloy was recrystallized by heating at 1200°C for 5 min. Results of preliminary tests indicated that cold-pressing of Ti–36% Al powder followed by sintering at 1250 to 1300°C for several hours may produce acceptable powder-metallurgy products. Annealed Ti–36% Al was machined with a carbide tool without a lubricant or coolant at a speed of about 45 surface ft/min, a cut of 0.005 to 0.010 in., and a feed of 16 threads/in. X-ray data indicated little or no occurrence of vacant lattice sites in the γ phase for compositions of 36%, 42%, 48% Al. (ASTIA abst.)

3476 AD-11048

Battelle Memorial Inst.

THE DEVELOPMENT OF INHIBITORS TO BE USED IN SAND CASTING OF ALUMINUM-BASE HIGH-MAGNESIUM ALLOYS: A REVIEW OF THE LITERATURE. INTERIM REPORT NO. 1. R. R. Studor, P. D. Frost, and J. H. Jackson. June 14, 1952. 17p. Contract DA-33-019-ORD-363.

The Al sand-casting alloy with 9.5 to 10.6% Mg has the best combination of yield strength, ductility, and corrosion resistance of any of the commercial Al sand-casting alloys. It is a difficult alloy from which to make sound castings, however, because of its tendency to react with both green and dry sand molds. A zone of unsoundness results, which may penetrate an inch from the reacting surface. Information is reported on the nature and methods of inhibiting the mold reaction of Al–10% Mg alloys; the information was derived from literature published over the past 10 years and from conferences with foundry metallurgists. A review of the literature on sand practice for casting Mg-base alloys is included. (ASTIA abst.)

3477 AD-13819

Horizons, Inc.

RESEARCH ON CLADDING OF BASE METALS. QUARTERLY PROGRESS REPORT NO. 1 [FOR] DECEMBER 15, 1952 TO APRIL 15, 1953. Peter F. Mataich, F. C. Wagner, and Merle E. Sibert. May 18, 1953. 19p. Contract AF33(616)-393.

Investigations were made of methods for producing integrally bonded Ti on base metal parts. Solid-state diffusion bonding by pressure welding and electrolytic deposition of Ti as an adherent layer on base metals were studied. The effects of rolling temperature, amount of plastic deformation, and atmosphere were factors also investigated. The pack-rolling method of cladding was used exclusively in these experiments. It consists of assembling steel outer layers with electroplated Ti inserts. Results of tests indicated that electroplated Ni and Fe layers on Ti, when alloy bonded by rolling at temperatures of 1400°F or above, form intermetallic phases which cause extreme weakness in the bond. The single experiment with a Cr-plated layer on Ti indicates that a good alloy bond is obtained between Cr and Ti at 1800°F. The cell employed for electrolytic cladding of Ti on steel is basically an inert atmosphere graphite unit heated by a

graphite resistance element. Initial preparation of the cell requires only an evacuation at 900 to 1000°C. Temperature and current variations were investigated within limited ranges. (ASTIA abst.)

3478 AD-15918
Engineering Research Inst., Univ. of Mich.
A STUDY OF CREEP OF TITANIUM AND TWO OF ITS ALLOYS. PROGRESS REPORT NO. 10 FOR THE PERIOD JANUARY 1, 1953 TO MARCH 31, 1953. J. V. Gluck and J. W. Freeman. Mar. 31, 1953. 25p. Contract AF 33(038)-14111.

Results of 500- and 1000-hr creep rates of as-received and heat-treated RC 130A at 76 and 600°F are presented. Metallographic examination was made of the material after testing with no change being noted. Analysis of available creep data was made on the basis of microstructure prior to testing. Behavior at both 76 and 600°F seemed to be related to β content and aging effects. An increase in β content resulted in a higher tensile strength of the water-quenched RC 130A at 76°F. Stress is 500- and 1000-hr creep rates at 76, 210, 400, and 600°F for as-received and heat-treated Ti 150A are reported. As in RC 130A, β gave the best creep resistance, its transformation to α or eutectoid lowering creep resistance in proportion to the temperature and manner of transformation. (J.A.G.)

3479 AD-15919
Engineering Research Inst., Univ. of Mich.
A STUDY OF CREEP OF TITANIUM AND TWO OF ITS ALLOYS. PROGRESS REPORT NO. 11 FOR THE PERIOD APRIL 1, 1953 TO JUNE 30, 1953. J. V. Gluck and J. W. Freeman. June 30, 1953. 29p. Contract AF33(038)-14111.

Creep testing was confined to Mn alloyed Ti (RC 130A) and Fe–Cr alloyed Ti (Ti 150A). The test temperatures for RC 130A were extended to 210 and 400°F. In addition, transverse testing of as-received and heat-treated conditions is reported. Preliminary results of transverse testing show higher creep resistance at 76°F and considerably higher resistance at 600°F than was found for longitudinal specimens. The effects of aging at 76, 400, and 600°F are discussed. The appearance of Ω-phase is believed to account for embrittlement of aged β-quenched samples and the appearance of negative creep phenomena. Transverse testing for Ti 150A is reported at 76 and 600°F. In addition, the occurrence of strain aging in the as-received material is discussed. (For preceding period see AD-15918.) (ASTIA abst.)

3480 AD-16386
Battelle Memorial Inst.
THE DEVELOPMENT OF MAGNESIUM ALLOYS HAVING IMPROVED ENGINEERING PROPERTIES. FINAL REPORT. M. W. Mote, P. D. Frost, and J. H. Jackson. July 31, 1953. 31p. Contract DA-33-919-ORD-934.

Success was achieved in introducing B into Mg alloys by 2 methods. One method consisted of bubbling gaseous BCl_3 through the melt; this produced B concentrations in Mg as high as 1.0 wt. %. The other method utilized an Al–B master alloy which was prepared by reducing KBF_4 with molten Al. Up to 0.03 wt. % B was added. The effect of B on the mechanical properties of the several Mg-base alloys was negligible. A new phase observed in these alloys was associated with their B content and was believed to exist, before freezing, as a solid in the melt. This conclusion was taken as an explanation of the difficulty of obtaining duplicate alloy samples. Ti was investigated briefly as an alloying element in Mg. The results indicated that the addition of Ti in amounts approaching the solubility limit did not materially affect the mechanical properties of the alloys. (auth)

3481 AD-18652
Armour Research Foundation
PHASE RELATIONSHIPS IN MAGNESIUM–LITHIUM–ALUMINUM ALLOYS. INTERIM TECHNICAL REPORT NO. 2 [FOR] NOVEMBER 1, 1952–JANUARY 31, 1953. D. W. Levinson and D. J. McPherson. Feb. 24, 1953. 24p. Contract DA-11-022-ORD-906.

3482 AD-18993
Jacobs Aircraft Engine Co.
BIBLIOGRAPHY ON ALUMINUM EXTRUSIONS. REPORT NO. 104-B-02. S. P. Kaprielyan. Apr. 28, 1953. 18p. Contract AF 33(616)-385.

The bibliography lists articles from the technical literature on the application of the aluminum extrusion technique to the production of helicopter and convertiplane rotor blades. The author and subject sections are arranged alphabetically. 178 references. (ASTIA abst.)

3483 AD-19447
Engineering Research Inst., Univ. of Mich.
INTERMEDIATE TEMPERATURE CREEP AND RUPTURE BEHAVIOR OF TITANIUM AND TITANIUM ALLOYS. QUARTERLY PROGRESS REPORT NO. 4 COVERING THE PERIOD APRIL 16, 1953 TO JULY 15, 1953. J. V. Gluck and J. W. Freeman. July 14, 1953. 65p. Contract AF 33(616)-244.

Creep and rupture behavior was studied on commercially pure Ti (Ti 75A), commercial martensite-forming alloy (Ti-150A), experimental α alloy Ti–6% Al, and experimental β alloy Ti–30% Mo. Rupture tests on Ti-75A and Ti-150A were made at 600, 800, and 1000° and on the experimental alloys at 600 and 1000°F. Metallographic and x-ray studies revealed changes in microstructure resulting from tensile and rupture testing. Both Ti-75A and Ti-150A showed relatively poor properties above 800°F. The experimental alloys had moderate tensile and rupture strength up to 600°F, yet were considerably stronger at 1000°F than the commercial alloys. All the alloys permitted relatively large amounts of loading and first stage creep deformation. Rupture life was high in relation to the amount of deformation. (ASTIA abst.)

3484 AD-22885
Armour Research Foundation
PHASE RELATIONSHIPS IN MAGNESIUM–LITHIUM–ALUMINUM ALLOYS. LETTER REPORT NO. 7 FOR THE PERIOD JANUARY 31, 1953 TO FEBRUARY 28, 1953. D. W. Levinson and D. J. McPherson. 5p. Contract DA-11-022-ORD-906.

3485 AD-25101
American Electro Metal Corp.
AN INVESTIGATION OF VARIOUS PROPERTIES OF NiAl. PART II. W. H. Herz. Sept. 1953. 51p. Contract AF-33(038)-10716.

Two 9.5-in.-long, stress-to-rupture specimens were prepared by hydrostatically pressing and sintering Ni–Al + 5% Ni rods and brazing the parts together. Attempts to sinter long bars of Ni–Al + 5% Ni by passing electric current through them in a "bell" and subsequent swaging to reduce the diameter were not completely successful.

The correct sintering cycle was not established. Bar cross-sections were reduced by swaging when sintering was accomplished to full density. Promising results were obtained on the extruding and slip casting of specimens. Stress-to-rupture experiments with 0.2-in. round bars indicated a loss of strength above 800°C. The addition of such stiffeners as Mo, $MoAl_2$, and Li to Ni–Al alloys increased high-temperature strength, but oxidation resistance was considerably decreased.

3486 AD-25917

Armour Research Foundation

STRUCTURAL CHANGES OF COMMERCIAL TITANIUM AND TITANIUM-BASE ALLOYS ON HEAT TREATMENT. QUARTERLY REPORT NO. 11 [FOR AUGUST 15 TO NOVEMBER 15, 1953]. D. W. Levinson and D. J. McPherson. Dec. 15, 1953. 23p. Contract AF33(038)-16347.

The time-temperature-transformation characteristics of a 3% Mn–Ti alloy have been determined resistometrically. This study includes the resistometric determination of the Ms temperature for this alloy. Additional data have been gathered for the 6% and 10% Mn alloys. Results to date in the study of the effect of dispersed carbides on the grain growth properties of an 11% Mo, Ti–Mo alloy are presented. (For preceding period see AD-18719.) (auth)

3487 AD-25929

Lubrication Lab., Mass. Inst. of Tech.

THE FRICTIONAL PROPERTIES OF TITANIUM AND ITS ALLOYS. ANNUAL PROGRESS REPORT [COVERING THE PERIOD] NOVEMBER 1, 1952 TO DECEMBER 31, 1953. E. Rabinowicz. Jan. 1, 1954. 37p. Contract NOa(s) 53-213-c.

An attempt was made to determine the mechanism responsible for the unfavorable frictional properties of Ti and to discover satisfactory lubricating conditions. All of the Ti alloys under study showed welding characteristics similar to those of pure Ti, and no success was obtained. Experiments involving different materials sliding on various Ti alloys indicated that good sliding conditions can be produced if the other metal is much softer than Ti and can bury the Ti fragments. In experiments with various viscous fluids, it was shown that within a series of chemically similar substances the frictional properties improve with viscosity. Ucon fluids and molasses were the best of the liquids investigated. Results of test using various solid lubricants indicated that the best lubricants are those that form strong, tightly bound films on the surface and that graphite and MoS_2 with various resins and lacquers as binders are suitable. Of the chemically active lubricants, those that act by destroying the surface layers of Ti were not successful, but heavily halogenated hydrocarbons that seem to act by adsorbing on Ti where the layers were destroyed during sliding yielded successful results. (auth)

3488 AD-26137

Allegheny Ludlum Steel Corp.

RESEARCH AND DEVELOPMENT OF WROUGHT AND CAST HIGH TEMPERATURE ALLOYS. PROGRESS REPORT NO. 3 [FOR] SEPTEMBER 16, 1953 TO DECEMBER 15, 1953. R. R. MacFarlane, R. S. DeFries, E. E. Reynolds, and W. W. Dyrkacz. Dec. 15, 1953. 24p. Contract AF18(600)-149.

Nine modifications of the Co-base S-816 wrought alloys were melted and rupture-tested at 1500 to 1700°F. Magnetism in the alloys appeared to be associated with the compositional balance between Co and Cr, Ni, W, and Mo; tendency for magnetism increased with Co content (60%). No improvement in notch-rupture properties was noted in 4 modifications of the Co-base U-912 alloys made with variations in Fe, W, Mo, Nb, and C. Eleven heats of Fe–Mn–Cr austenitic steels indicated the influence of C and N on notch-sensitivity properties. Results indicated an alloy containing 0.3 C, 0.2 N, 3.0 Mo, 18.0 Mn, 12.0 Cr, and 0.8 V should have a good combination of properties. Two heats each of Vitallium, F-88, and F-87 cast alloys were fabricated for use in thermal-shock evaluation and for correlation with room-temperature tensile and high-temperature rupture properties. The F-88 and F-87 alloys failed transgranularly in thermal shock, whereas Vitallium failed intergranularly. Vitallium failed after 1000 to 2000 c, F-88 after 700 to 2200 c, and F-87 after 600 to 900 c. (ASTIA abst.)

3489 AD-26534

Armour Research Foundation

STUDY OF EFFECTS OF ALLOYING ELEMENTS ON THE WELDABILITY OF TITANIUM SHEET. QUARTERLY PROGRESS REPORT NO. 4 [COVERING THE PERIOD JULY 15, 1953 TO OCTOBER 31, 1953]. H. M. Meyer and W. Rostoker. Dec. 15, 1953. 14p. Contract AF 33(616)-206.

Preparation is described of the Ti–N, Ti–O, and Ti–C master alloys. The method of double inert-gas arc melting is discussed. Forging temperatures were generally between 2000 and 1650°F. Test specimens were prepared from sheet $\frac{1}{16}$ in. thick. Longitudinal and transverse guided- and free-bend tests were performed, as well as transverse tensile and hardness tests and microstructural examinations. Welding and heat treating practices are described. A wiring diagram is included. (For preceding period see AD-30314.) (ASTIA abst.)

3490 AD-26735

Battelle Memorial Inst.

THE DEVELOPMENT OF A FORGEABLE HIGH-STRENGTH, HIGH-TEMPERATURE, CHROMIUM-RICH, CHROMIUM–IRON ALLOY. PROGRESS REPORT NO. 6 COVERING THE PERIOD SEPTEMBER 19 TO DECEMBER 18, 1953. D. P. Moon, H. A. Blank, and A. M. Hall. Dec. 21, 1953. 12p. Contract [AF-33(616)-222].

Attempts were made to produce forgeable larger size ingots of the 70 Cr–30 Fe alloy (parts by weight), with 6.5 Mo, 2 Ti, and 0.5 Al. Three heats of 2 ingots each were melt and cast which were charged with Fe, fused Cr, ferromolybdenum, ferrotitanium, and Al. In the last heat, a high-temperature-refractory funnel for pouring the melt was substituted for the core-sand tun dish to reduce dross. None of the melts showed forgeability. In subsequent heats, variations in melting and casting practice were tested. Commercially pure metals were substituted for the ferroalloys of Mo, Ti, and Mn. A more powerful deoxidizer (0.06% Mg as Ni–Mg alloy) was tried. A Ti–Therm slag was satisfactory when casting into metal molds. The graphite used to produce a carbide slag in one heat may not have been sufficiently reactive to form carbide. A double-size hot top was employed to promote better feeding of the ingot. Large ingots with 9 parts by weight of Mo were difficult to deform at 2300°F, but 12-lb ingots were readily forged without cracking to bars $\frac{5}{8}$ in. square. (ASTIA abst.)

3491 AD-27052
Battelle Memorial Inst.
SPOT-WELDED JOINTS IN TITANIUM ALLOYS AND THEIR BEHAVIOR IN FATIGUE. PROGRESS REPORT [COVERING PERIOD NOVEMBER 10, 1953 TO JANUARY 10, 1954]. W. H. Kearns, W. S. Hyler, and D. C. Martin. Jan. 10, 1954. 15p. Contract AF-33(616)-2005.

The brittleness in spot welds of 0.040-in. RS-55 commercially pure Ti sheets was not reduced when the H content was lowered from 0.019 to 0.005 wt. % by vacuum annealing at 1600°F. Several 0.040-in. Ti–7% Mn (RS-120) alloy specimens were made and tested. The average cross-tension strength of 10 specimens was 560 lb, and the average tension-shear strength of 9 specimens was 2200 lb. The tension-to-shear ratio was 0.25. Metallographic examination of a cross section through the center of a furnace heat-treated spot weld revealed that the structure was a coarse α-phase in a β-matrix. An unstable γ-phase was obtained with a nonheat-treated spot weld. Vickers hardness readings, taken on the cross section through the furnace heat-treated spot weld, were 304 for the base metal and 290 for the weld nugget. Tension-shear and cross-tension tests of as-welded spots gave an average tension-shear load of 2000 lb and an average cross-tension load of 280 lb. The tension-to-shear ratio was 0.14. A technique is given for fabricating an experimental alloy, Ti–5% Al–2½% Sn alloy (Rem Cru A-110), into 0.040-in. sheet. (ASTIA abst.)

3492 AD-28277
Battelle Memorial Inst.
THE EFFECT OF GRAIN SIZE ON THE MECHANICAL PROPERTIES OF TITANIUM AND ITS ALLOYS. QUARTERLY PROGRESS REPORT NO. 4 [FOR OCTOBER 1, 1953 TO JANUARY 1, 1954]. F. C. Holden, A. A. Watts, H. R. Ogden, and R. I. Jaffee. Jan. 1, 1954. 23p. Contract AF33(616)-412.

Flow curves, flow constants, and corrected bend-test data are presented for the preliminary alloy program. An increase in grain size lowered the initial flow stress, but increased the strain at maximum load of unalloyed Ti in the equiaxed α condition. Flow curves for the Ti–5.0 Cr–5.0 Mo α-β composition were relatively insensitive to increasing grain size. The full-scale alloy program was designed to make use of semimicro specimens for the determination of fatigue and impact-transition properties. Details are presented on the mechanical tests and heat treatments which are scheduled for commercial Ti, the Ti–7.5 Cr–7.5 Mo alloy, and the Ti–2.5 Cr–2.5 Mo alloy. (ASTIA abst.)

3493 AD-30314
Armour Research Foundation
STUDY OF EFFECTS OF ALLOYING ELEMENTS ON THE WELDABILITY OF TITANIUM SHEET. THIRD QUARTERLY REPORT. H. M. Meyer and John M. Parks. May 11, 1953. 155p. Contract AF33(616)-206.

The following studies are reported: microstructure and hardness of spot and arc welds of Ti–75A; tensile properties, hardness, and microstructure of as-received and welded MST-alloy (2.5% Fe–Ti–25% U); phase studies, bend ductility, and tensile strength of welded and unwelded RC-130A and hardness traverses and microstructures of the welded sheet; phase studies of Al–Ti; and weldability studies of as-rolled and heat-treated Al–Ti alloys containing 3, 5, and 8% Ti and bend ductility, tensile properties, hardness traverses, and microstructures of each. The results are discussed and evaluated. (J.A.G.)

3494 AD-33675
Battelle Memorial Inst.
CAUSES OF CRACKING IN HIGH-STRENGTH WELD METALS. PROGRESS REPORT [FOR THE PERIOD] DECEMBER 12, 1953 TO MARCH 12, 1954]. A. J. Jacobs, R. P. Sopher, and P. J. Rieppel. Mar. 12, 1954. 23p. Contract AF 33(038)-12619.

3495 AD-35092
Camin Labs., Inc.
FINAL REPORT [ON THE PRODUCTION OF FUNNELS, TUBES AND TRUMPETS IN VARIOUS METALS BY THE PROCESS OF ELECTROFORMING]. S. Fialkoff. [nd]. Contract DA-30-069-ORD-346.

3496 AD-35134
Brush Labs. Co.
BASIC RESEARCH ON SINTERED TITANIUM POWDER ANALOGOUS TO "SAP" FOR HIGH TEMPERATURE STRENGTH. BI-MONTHLY REPORT [FOR] JULY 1, 1953–SEPTEMBER 1, 1953. E. P. Weber and G. F. Davies. 9p. Contract NOas-53-722-C.

Titanium powders were mixed with Al_2O_3, MgO_2, and ZrO_2 by ball milling, and vacuum hot pressed at 1000°C and 900 psi for 8 hrs. Densities obtained for the compacts were unsatisfactory, and machining of the MgO alloys proved very difficult because of the extreme hardness and brittleness. Attempts to produce uniform Si coatings on Ti powders by using Si carbide and Cl_2 at 1700 to 1850°F in a normal atmosphere after flushing with He, proved unsuccessful. (L.M.T.)

3497 AD-41800
Battelle Memorial Inst.
DEVELOPMENT OF HIGH-STRENGTH FILLER METALS FOR WELDING SAE 4130, 4140, AND 4340 STEELS. PROGRESS REPORT. H. W. Mishler and R. P. Sopher. May 31, 1954. 11p. Contract AF33(616)-2339.

High-strength filler metals for inert-gas tungsten-arc and inert-gas consumable electrode welding of aircraft steels were developed. The advantages of the welding processes used over the conventional shield-arc welding with coated electrodes are discussed. (auth)

3498 AD-44180
Research Inst., Temple Univ.
OFFICE OF NAVAL RESEARCH HIGH TEMPERATURE PROJECT. PROGRESS REPORT NO. 8 [FOR JANUARY 1, 1953 TO JULY 1, 1953]. J. B. Conway and A. V. Grosse. July 1, 1953. 33p. Contract N9-onr-87301.

Progress is reported on the following studies: radiation measurements on oxy-aluminum flames at elevated temperatures; combustion of Al at subatmospheric pressures; combustion of Ti powder; and thermodynamics of the Ti–O_2 system. (J.A.G.)

3499 AD-44262
Armour Research Foundation
EVALUATION OF HIGH STRENGTH WELDABLE TITANIUM-BASE ALLOYS. QUARTERLY REPORT NO. 2 [FOR] FEBRUARY 15, 1954 TO MAY 15, 1954. C. R. Lillie and D. J. McPherson. July 23, 1954. 19p. Contract AF33(616)-2321.

The current status of alloys in this program is stated. Tensile tests, bend tests, and hardness tests are shown for six alloys: Ti–4 Al–2 V, Ti–4 Al–4 V, Ti–6 Al–2 V, Ti-

6 Al–4 V, Ti–7 Al–4 V, and Ti–6 Al. Tests are reported for both welded and unwelded material, with some tensile tests performed at 700°F. Heat treatments employed lay in the range of 750 to 1650°F, usually consisting of one hour at temperature, followed by a water quench. The best results to date, based on the value of the 0.2% offset yield strength at 700°F, are those for the Ti–4 Al–4 V, Ti–6 Al–2 V, and Ti–6 Al–4 V alloys; as heat treated, these alloys are competitive with stainless steel on a strength-weight basis. (auth)

3500 AML-NAM-AE-4146
Aeronautical Materials Lab., Naval Air Experimental Station, Philadelphia
FATIGUE TESTS OF TITANIUM, STAINLESS STEEL AND ALUMINUM ALLOY SEAMWELDED SPECIMENS. Joseph Viglione. July 27, 1954. 27p. (AD-44201)

The fatigue strengths of RC-70 and RC-130A seam-welded titanium alloy sheet materials were evaluated, using similar Type 321 stainless steel and clad 24S-T3 aluminum alloy specimens as a basis for comparison. Similarly, the fatigue strength of RC-130A spotwelded titanium alloy sheet material was evaluated and compared to RC-70 titanium alloy. Type 302 stainless steel and clad 24S-T3 aluminum alloy previously evaluated at this station. S-N curves were drawn and fatigue and static strengths of the seam and spotwelded specimens were determined. It was found that the titanium alloy RC-70 spot and seam-welded specimens were superior to similar specimens fabricated from the other materials tested and reported, when evaluated on a strength-weight basis. (auth)

3501 ANL-5359
Argonne National Lab.
EQUIPMENT AND PROCEDURES FOR STUDYING THE EQUILIBRIUM SOLUBILITY OF IRON IN NaK. P. G. Drugas and L. R. Kelman. Sept. 4, 1953. 29p. Contract W-31-109-Eng-38.

This study of the equilibrium solubility of Fe in NaK was part of a program to investigate the mechanisms whereby solid metals are attacked by liquid metals in engineering systems. Careful consideration was given to several experimental solubility methods, and the equipment and procedures are described in detail. A trial run of the most promising method was made, and the equilibrium solubility of Fe in NaK at 700°C was found to be 15 ± 3 ppm. The solubility methods that were devised made no provision for particles of Fe that might remain suspended in NaK upon precipitation from saturated solutions on cooling. In tests that were performed to determine the degree to which this phenomenon occurred, little, if any, tendency for suspension was found. (auth)

3502 CAL-KA-797-M-12
Cornell Aeronautical Lab., Inc.
DEVELOPMENT OF SUBSTITUTE ALLOYS FOR HIGH TEMPERATURE USE. BIMONTHLY PROGRESS REPORT. J. Salvaggi and G. J. Guarnieri. Aug. 31, 1954. 11p. Contract NOa(s)-52-368-c. (AD-44847)

In the course of evaluating the high-temperature properties of three selected compositions of titanium–boron bearing stainless steels, creep-rupture properties of three 30-pound heats have been determined at 1500°F after solution treating at 2100 or 2300°F plus finish rolling at 2000°F with approximately 10% reduction. Rupture ductility was not enhanced for material finish rolled following the high-temperature solution treatment. Addition of zirconium to a type 316 stainless steel containing titanium, titanium plus boron, or titanium plus boron plus tungsten, resulted in no consistent benefit to strength properties for material solution treated at 2300°F and tested at 1500°F, although without titanium, boron, or tungsten, zirconium appeared to be beneficial. Tungsten added to a type 316 stainless steel containing titanium or titanium and boron combined, tended to stabilize the strength properties, decreasing the sensitivity of these alloys to minor changes in chemical composition. (auth)

3503 CAL-KB-836-M-6
Cornell Aeronautical Lab., Inc.
COMPRESSIVE-STRESS-RUPTURE PROPERTIES OF HIGH TEMPERATURE MATERIALS. QUARTERLY PROGRESS REPORT FOR THE PERIOD JANUARY 15, 1954 TO APRIL 15, 1954. L. A. Yerkovich and G. J. Guarnieri. 13p. Contract AF33(616)-245. (AD-32652)

Recent compression creep tests on cast Stellite 21 at 1600°F indicate that creep deformation of this alloy when compared to published tensile data undergoes an acceleration under compression loads. Tensile tests have been conducted on cast Stellite 21 to compare the tension-compression creep characteristics at the 1600°F temperature level. These comparisons are presented in tabular and various graphic forms for a series of stresses to illustrate the difference in creep behavior due to type of applied load. Compression creep characteristics of wrought S-816 alloy for several stresses at 1600°F are also included and represented as time-deformation and stress-time curves. Compared with published tensile data, the wrought S-816 alloy exhibits large differences in its tension-compression creep behavior displaying less resistance to compressive load. (auth)

3504 CAL-KB-836-M-7
Cornell Aeronautical Lab., Inc.
COMPRESSIVE-STRESS-RUPTURE PROPERTIES OF HIGH TEMPERATURE MATERIALS. QUARTERLY PROGRESS REPORT FOR THE PERIOD APRIL 15, 1954 TO JULY 15, 1954. L. A. Yerkovich and G. J. Guarnieri. 15p. Contract AF33(616)-245. (AD-44846)

A study to determine and evaluate the elevated-temperature compression-creep characteristics of high-temperature materials is in progress. Previous data dealing with several alloys in this investigation showed a decreased resistance to creep-deformation associated with compression when compared with published tensile data for these alloys. So that direct comparisons could be made to evaluate tension-compression creep characteristics, static tension and compression creep tests have been conducted on wrought S-816 at 1600°F. These comparison data are presented in tabular and graphical forms to illustrate the major creep-deformation differences observed for this alloy. Additional compression-creep data have been compiled for wrought Nimonic 90 and Kennametal K-162B metal-ceramic at 1600 and 1800°F respectively. The creep characteristics of these materials for a number of static compression stresses are summarized in tables and presented graphically in conventional curves relating time with total deformation and stress with time. (For preceding period see CAL-KB-836-M-6.) (auth)

3505 CAL-KB-914-M-2
Cornell Aeronautical Lab., Inc.
QUARTERLY PROGRESS REPORT ON RELAXATION OF

TITANIUM AND TITANIUM ALLOYS. F. J. Vawter and G. J. Guarnieri. Oct. 1, 1954. 19p. Contract AF 33(616)-2340.

Two relaxation test machines have been constructed and trial operated to determine the performance characteristics of the apparatus. The various control and recording features for maintaining constant strain and temperature in the specimen gage length, recording of stress versus time, and initial loading of the specimen at relatively rapid rates were found to be very satisfactory. As a check of the reproducibility of relaxation data obtainable from the apparatus, three separate samples of commercially pure titanium were relaxation tested at 800°F and 15,000 psi initial stress. Duplicate tests were also made for a 24S-T4 aluminum alloy at 450°F. Excellent reproducibility of results was obtained. (auth)

3506 CAL-KB-914-M-3

Cornell Aeronautical Lab., Inc.

QUARTERLY PROGRESS REPORT ON RELAXATION OF TITANIUM AND TITANIUM ALLOYS. F. J. Vawter and G. J. Guarnieri. Jan. 1, 1955. 3p. Contract AF33(616)-2340.

The effect of microstructure of commercially pure Ti and Ti alloys on their relaxation behavior was studied. Relaxation tests were conducted at 800°F after annealing for 1 hr at 1500°F. Initial stresses for the tests were 5,000, 10,000, and 15,000 psi. (J.E.D.)

3507 EES-9C(3)966861

Naval Engineering Experiment Station, Annapolis

BASIC INFORMATION ON THE BEARING PROPERTIES OF VARIOUS MATERIALS IN LIQUID METALS. [REPORT NO. 3]. M. R. Gross and W. J. Greenert. Feb. 28, 1952. 35p.

Additional results on rolling contact, sliding contact, and hot hardness tests are presented. The data support the hypothesis that welding and seizure of both the rolling and sliding components are responsible for the premature failure of standard antifriction bearings in the NaK tests at this Station. Sliding contact tests in NaK up to and including 500°F continue to show a superiority for aluminum base alloys. The materials tested in the hot hardness tester showed little or no change in room temperature and hot hardness after 5000 hours in NaK at 750°F. A discussion of the results and plans for future tests are also presented. (For preceding report in series see EES-9C(2) 966861.) (auth)

3508 ITL-4135

Industrial Test Lab., Philadelphia Naval Shipyard

STRENGTH OF JOINTS IN ALUMINUM ALLOYS 61S–T6 AND 52S–H34 WELDED BY THE SEMIAUTOMATIC INERT-GAS METAL-ARC PROCESS USING 43S ALUMINUM ALLOY FILLER METAL. Apr. 1952. 70p. (U-63691)

The strength levels and efficiencies of a variety of welded joints fabricated with aluminum alloys 61S–T6 and 52S–H34 using 43S filler metal with the semiautomatic inert-gas metal-arc welding process are reported. Welds were made in $\frac{1}{4}$-in., $\frac{3}{8}$-in., and $\frac{1}{2}$-in. 61S-T6, and $\frac{3}{8}$-in. 52S-H34 base plates with $\frac{1}{16}$-in. diameter 43S filler electrode using helium for the inert gas shield. A series of welded assemblies covering unstrapped and single and double strapped groove joints were prepared to determine their relative joint efficiencies. In this series of assemblies, the fillet size and strap width of the single and double strap joints were varied. The deposition of several fillets was accomplished by using a single and a multipass procedure. Duplicate assemblies in $\frac{3}{8}$-in. thick base plates of the two alloys were fabricated to determine their comparative strength levels and joint efficiencies. Assemblies of the two alloys in $\frac{1}{4}$-in. plate were welded to determine the comparative stress-strain relationships and yield strength of welded and unwelded specimens. (auth)

3509 MR-582

Pitman-Dunn Labs., Frankford Arsenal

SOME MECHANICAL PROPERTIES OF A NEW BERYLLIUM–COPPER ALLOY. J. C. Kiszka and L. M. Smith. Jan. 1954. 18p. (AD-24476)

Data were obtained concerning the tensile strength (TS), yield strength, elongation, and hardness-vs-aging time of Berylco XP-112 samples consisting of 1.10 to 1.25% Be, 0.20% Co, 1.60% Zn, and balance Cu. Aging curves were determined at 650, 685, and 715°F. Tests of the samples indicated an ultimate TS of 150,000 psi with 7% elongation, which was about 25% lower than the TS of commercial 1.9% Be–Cu alloy. The microstructure revealed a gradual increase in grain boundary precipitate as aging increased. (auth)

3510 NAVORD-2072

Naval Ordnance Test Station, Inyokern

EFFECT OF UNSTABLE MICROSTRUCTURE ON HIGH-HEATING-RATE STRENGTH OF MAGNESIUM AND MAGNESIUM ALLOYS. B. A. Miller, W. J. Feuerstein, and W. K. Smith. Nov. 10, 1953. 18p. (AD-24308)

High-heating-rate strength data were obtained for FS-1h and FS-1a magnesium alloys and for 24S-T3, 24S-0, 56S-H16, 56S-0, 2S-H18, 2S-0, 356-T6, 356-0, 75S-T6, and 75S-0 aluminum alloys. The curves of stress vs. temperature at 0.2% offset for FS-1h and FS-1a crossed each other. The same behavior was found in 24S and 56S but not in 2S, 356, or 75S aluminum alloys. The rapid solution with rapid heating of very fine precipitates of the major alloying constituents was suggested as the cause. (auth)

3511 NOTS-TM-789

Naval Ordnance Test Station, Inyokern

HIGH-HEATING-RATE STRENGTH OF 356-T6 ALUMINUM ALLOY. W. J. Feuerstein and W. K. Smith. Feb. 5, 1953. 10p. (AD-30744)

High-heating-rate strength tests were made on 356-T6 aluminum alloy cast in $\frac{7}{16}$-inch thick plates and machined into special test specimens. Three heating rates, 25, 65, and 190°F per second, and a range of stresses up to the yield strength of the material were employed in these tests. Temperatures at 0.2% offset for the high-heating-rate tests did not vary greatly over the range of heating rates employed, but were considerably higher than those indicated by standard short-time high-temperature tensile data from the literature. (auth)

3512 NP-5575

[Naval Underwater Ordnance Station, Newport, R. I.]

RESUMÉ OF THE EXPERIENCE OF THE U. S. NAVAL TORPEDO STATION WITH WELDING IN THE FABRICATION OR REPAIR OF PURE ALUMINUM NAVOL TANKS FOR HYDROGEN PEROXIDE SERVICE. [Aug. 9, 1950]. 29p.

The welding methods concerned with Navol tanks were found to be both good and bad depending upon the degree of skill of the welder. The important factor with respect to welding in the tanks is the condition of the welded zone on

the interior which comes in contact with the H_2O_2. It was found that the surface should be free from traces of contaminating heavy metals and porosity; cracks and non-homogeneities should be avoided. (J.E.D.)

3513 PA-TR-1988

Picatinny Arsenal

DEVELOPMENT OF SPECTROGRAPHIC METHODS OF ANALYSIS. UNIVERSAL SPECTROGRAPHIC METHOD FOR THE ANALYSIS OF ALUMINUM ALLOYS. H. M. Hyman and S. Weisberger. Jan. 15, 1954. 44p.

A universal spectrographic method is described for the determination of the following elements in the given ranges in aluminum alloys: manganese 0.01 to 0.81%, copper 0.3 to 5.2%, magnesium 0.08 to 1.6%, zinc 0.03 to 2.0%, iron 0.2 to 1.5%, chromium 0.01 to 0.38%, nickel 0.02 to 0.59%, calcium 0.2 to 1.3%, titanium 0.01 to 0.16%, lead 0.01 to 0.14%, silicon 0.05 to 6.2%. Greater percentages than those listed above can be determined by proper dilution of the sample with pure aluminum powder or with pure aluminum sulfate. The method is considered satisfactory for the purpose of classifying aluminum alloys into type categories, and can also be used, to a limited extent, in specification analysis. The established method is applicable to any sample of aluminum alloy, regardless of size, shape, or composition. (auth)

3514 RDB(W)/TN-166

Research and Development Branch, Industrial Group, Windscale Works, United Kingdom Atomic Energy Authority, Windscale, Cumb. (England)

ARGONARC WELDING MACHINE FOR THE ROOT-RUN IN THREE INCH STAINLESS STEEL PIPELINES. E. K. Richardson and C. O'Grady. [nd] 19p. (EMC/P-34)

The development of a prototype automatic machine for the all-position argon-arc welding of the root run in Nb-stabilized stainless steel pipelines is described. (auth)

3515 RDB(W)/TN-181

Research and Development Branch, Industrial Group, Windscale Works, United Kingdom Atomic Energy Authority, Windscale, Cumb. (England)

SMALL BORE ARGON ARC PIPE WELDING MACHINE FOR THE ROOT RUN IN Nb-STABILIZED STAINLESS STEEL. E. K. Richardson. Jan. 1955. 21p. (EMC/P-37)

The development of a prototype automatic machine for the all-position argon-arc welding of the root run in small bore Nb-stabilized stainless steel pipelines is described. Preliminary trials have shown that satisfactory welds are obtained having good underbead penetration. (auth)

3516 WADC-TR-52-145(Pt.2)

Armour Research Foundation

EXPLORATION OF VANADIUM-BASE ALLOYS. [REPORT FOR PERIOD MAY 14, 1952 TO MAY 14, 1953]. William Rostoker, Donald J. McPherson, and Max Hansen. Nov. 1954. 108p. Contract AF33(038)-8517.

The forgeability of a large number of binary alloys was investigated. While many proved forgeable, the room-temperature ductilities of all but vanadium–titanium and vanadium–zirconium alloys were poor. Ternary alloys based on vanadium–titanium were investigated. Elevated temperature tensile properties have shown much promise. Studies on improvement of the oxidation characteristics of vanadium alloys have proved fruitful; chromium and aluminum additions were found to be particularly effective. A number of alloys have demonstrated sufficient resistance for 100 hr at 700°C. Limited studies were conducted on the systems vanadium–oxygen and vanadium–nitrogen. (auth)

3517 WADC-TR-52-145(Pt.3)

Armour Research Foundation

[RARE AND UNUSUAL METALS. ANNUAL REPORT NO. 3 FOR THE PERIOD MAY 15, 1953 TO JUNE 14, 1954]. EXPLORATION OF VANADIUM-BASE ALLOYS. Albert S. Yamamoto and William Rostoker. Jan. 1955. 75p. Contract AF 33[038]-8517.

The oxidation study on vanadium alloys has been further pursued, and the conclusion has been reached that satisfactory oxidation resistance at elevated temperature of vanadium-base alloys cannot be rendered by alloying alone but possibly by electroplating. Major efforts have been directed toward evaluating the elevated temperature tensile and stress-rupture strengths of the alloys under development. Carbon additions have proven beneficial as far as the forgeability is concerned. In certain cases superior tensile ductilities are observed while no effect in stress-rupture behavior results. The current availability of less expensive vanadium–aluminum alloy produced by the alumino-thermic reduction process has promoted a feasibility study of its use. It is found that the alloys made of this are as competitive in mechanical properties as the equivalent alloys based on the very expensive calcium-reduced vanadium metal. A range of alloy compositions containing additions of titanium and aluminum have shown stress-rupture behavior which is as good or marginally better than the best titanium-base alloys. (auth)

3518 WADC-TR-53-101

Battelle Memorial Inst.

TITANIUM ALLOYS FOR ANALYTICAL STANDARDS. H. W. Lownie, Jr., D. L. Chase, and W. M. Henry. May 1953. 25p. Contract AF33(600)-6850. (AD-15926)

Titanium alloys were prepared for tentative chemical standards. The alloys were melted, chipped, and analyzed. A detailed description is included of the chemical and spectrographic procedures for the analyses of sixteen 10-lb Ti ingots. Analytical results were close to the intended compositions and showed the individual samples to be uniform within the limits of accuracy of the analytical techniques. (auth)

3519 WADC-TR-53-151(Suppl.1)

Cornell Aeronautical Lab., Inc.

STUDY OF HARD COATING FOR ALUMINUM ALLOYS. F. J. Gillig. Oct. 1953. 21p. Contract AF18(600)-98. (AD-24017)

The program for the study of the effects of hard oxide coatings (produced by the MHC Process) on the properties of aluminum and its alloys was extended in order to provide additional data. The corrosion resistance in three environments was evaluated up to 11 months. The abrasion resistance showed another small decrease with the five-month additional exposure to atmospheric and high humidity conditions. Two treatments that were given the coatings on 61S and 75S alloys appear to alleviate the drastic reduction in fatigue strength brought about by the coatings. Attempts at retaining the abrasion resistance in a humid atmosphere were only moderately successful. Oil was found to have a detrimental effect on the resistance to an erosion type of wear. (auth)

3520 WADC-TR-53-182
Armour Research Foundation
INVESTIGATION OF THE METALLU[R]GICAL CHARACTERISTICS OF THE 36% ALUMINUM–TITANIUM-BASE ALLOY. Harold D. Kessler and Joseph B. McAndrew. July 1953. 39p. Contract AF-33(616)-196. (AD-26622).

Experience with melting, casting, forging, and machining of Ti–36% Al alloy of high purity and commercial grades is reported and discussed. Results of a few tensile tests at room temperature and 1000°C and of several oxidation tests at 1000°C in air are given. Hardness, metallography, and lattice parameters for various ternary alloys based on Ti–36% Al are listed. (auth)

3521 WADC-TR-53-336(Pt. 1)
Institute of Engineering Research, Univ. of Calif., Berkeley
[DESIGN AND EVALUATION DATA FOR STRUCTURAL METALS]. THE CREEP PROPERTIES OF METALS UNDER INTERMITTENT STRESSING AND HEATING CONDITIONS. PART I. INTERMITTENT STRESSING. Lawrence A. Shepard, C. Dean Starr, Carl D. Wiseman, and John E. Dorn. Sept. 1953. 113p. Contract AF 33(038)-11502. (AD-23715)

Constant- and intermittent-load creep tests were performed on clad Al alloys 75S-T6 and 24S-T3 at 300, 450, and 600°F, and on cold-rolled Ti at 400°F. Constant-load creep tests were also conducted on annealed Ti-75-A at 400°F. The effect of stress on the constant-load creep curve were, to a good first approximation, correlated in terms of the functional relationship (1) $\epsilon = F\{tf(\sigma)\}$ where ϵ = creep strain, t = time under test, σ = stress, and F and f are functions. The equation suggested that a homologous series of creep curves are obtained with increasing values of the stress. The times to achieve the same strain in 2 creep tests at 2 different stresses were related by $t_1 = f(\sigma_2)/f(\sigma_1)\ t_2 = Kt_2$ where the factor K is practically independent of the creep strain. Intermittent stress creep tests also appeared to adhere to the approximate relationship given by (1). For the range of conditions investigated, $f(\sigma)$ was independent of stress cycling, and about the same K factors were obtained for cyclic- and constant-load creep curves. On the basis of total test time, creep was more rapid under constant-load than under either of the 2 cyclic-loading conditions where the load was applied for 1 and 1½ hr out of every 2, respectively. On the basis of net time under load, almost identical creep curves were obtained for the 1½-hr and the 1-hr stress periods of the 2-hr intermittent stress cycles. (ASTIA abst.)

3522 WADC-TR-53-451
Battelle Memorial Inst.
[SUBSTITUTES FOR CRITICAL AND STRATEGIC MATERIALS]. THE DEVELOPMENT OF A FORGEABLE HIGH-STRENGTH, HIGH-TEMPERATURE, CHROMIUM-RICH, CHROMIUM–IRON ALLOY. D. P. Moon, H. A. Blank, and A. M. Hall. Jan. 1954. 22p. Contract AF 33(616)-222. (AD-27583)

The development of a forgeable high-strength, high-temperature, chromium-rich, chromium–iron alloy is described. Experimental alloys were produced by induction melting 4- and 12-pound charges of commercially available melting stock, casting into rammed zirconite molds, and forging to ⅝-inch-square bars for testing. Stress-rupture properties of alloys containing approximately 70Cr, 30Fe, 9Mo, 2 to 3Ti, and up to ½Al (parts by weight) were excellent, but room-temperature ductility was poor. Some ductility was obtained after heat treatment in warm-rolled strip of the compositions 55Cr, 45Fe, 1Ti and 60Cr, 40Fe, and 1Ti. It is concluded that the 70Cr–30Fe-base alloy containing about 9Mo, 2 to 3Ti, and up to ½Al shows promise as a material of construction for turbine buckets in turbojet aircraft. (auth)

3523 WADC-TR-54-88
Battelle Memorial Inst.
[STRUCTURAL ADHESIVES]. NONDESTRUCTIVE TESTING OF METAL-TO-METAL STRUCTURAL ADHESIVE BONDS. B. A. Kulp, M. E. Greenstreet, and J. H. Cahn. Apr. 1954. 12p. (AD-34417)

A theoretical study of electrical characteristics of metal-to-metal adhesive bonded joints, with emphasis toward developing a satisfactory nondestructive test to determine quality of the bond, is presented. To supplement the theoretical study, electric and sonic tests were conducted on adhesive bonded joints fabricated under close laboratory control. The results indicate that more extensive research on electrical characteristics of adhesive-bonded joints must be conducted to establish definite correlation to bond quality. (auth)

3524 WADC-TR-54-101
Armour Research Foundation
STUDIES OF PHASE RELATIONSHIPS AND TRANSFORMATION PROCESSES OF TITANIUM-ALLOY SYSTEMS. [SUMMARY REPORT COVERING PERIOD JANUARY 8, 1953 TO JANUARY 8, 1954]. Donald J. McPherson and William Rostoker. Oct. 1954. 131p. Contract AF 33(038)-8708.

Time-temperature-transformation charts have been determined for the following titanium-base alloys, which are of interest for high-temperature application: 8% Al–6% Mo, 8% Al–4% Mo, 6% Al–6% Fe, 6% Al–6% Mn, and 8% Al–4% Cr. Alloys in the titanium-rich corner of the Ti–Mo–V system were investigated. The locus of minimum total compositions for the complete retention of beta phase on quenching was determined. Aging studies showed that none of the alloys investigated are permanently β stable. The alloys are evaluated from the standpoint of probable ability to retain ductility under elevated temperature service conditions. Because of the promising behavior of Ti–Al–V alloys at elevated temperatures, the phase relationships in the titanium-rich corner of this system were determined. The investigation covered the space bounded by Ti–22% Al, Ti–11% V, and 600° to 1200°C. Seven isothermal sections and three selected vertical sections are presented and the phase relationships are discussed. Phase relationships in the titanium-rich corner of the Ti–Al–Si system were studied for similar reasons. The space bounded by Ti–8% Al, Ti–2% Si and 600° to 1200°C was covered. The diagram is represented by six isothermal and four selected vertical sections. As a prerequisite for the study of possible age hardening titanium-base systems, the solubility limits of silicon, boron, beryllium, and carbon in the base compositions Ti–4% V, Ti–3% Mo, and Ti–2% Cr were investigated. The carbon-containing alloys were not completed. Information on the other systems is presented in the form of nine partial vertical sections. From this information, selection of the amounts of third component additions and solution treatment temperatures for aging studies will be made. The formation of two separate and reproducible martensites, both based

on a hexagonal lattice, upon quenching binary alloys containing 7 and 9% molybdenum was discovered. No such dual martensitic phases were produced upon similar treatment of Ti–Cr and Ti–Mn alloys. The method of integrated x-ray diffraction line intensities was proved to be unsuitable for determining the relative amounts of β and α' phases in titanium alloys. (auth)

3525 AEC-tr-2105

ON THE DETERMINATION OF THE NUMBER OF VACANCIES AND THE ENERGY OF VACANCY FORMATION IN METALS AND ALLOYS. S. S. Gertzriken. Doklady Akad. Nauk S.S.S.R. 98, 211-13(1954). 5p.

In connection with the heat treatment of metals and alloys self-diffusion and interdiffusion are determined by studying the mobility of the atoms. The most commonly occurring type of diffusion in metals and alloys is vacancy diffusion. In experiments on internal friction where the mobility is measured from the speed of inelastic relaxation, the equilibrium number of vacancies and the energy of vacancy formation can be determined. (J.E.D.)

3526 AERE-Lib/Trans-495

CHANGES IN THE DIMENSIONS OF DIFFUSION SAMPLES. Wolfgang Seith and Rudolf Ludwig. Translated by F. Hudswell from Z. Metallkunde 45, 550-4(1954). 6p.

In addition to the change in length of diffusion test pieces (consisting of two metallic cylinders welded to each other) in the direction of diffusion, the question of a change in the cross sectional area was investigated. It is shown that, in addition to the building up and removal of lattice planes at right angles to the direction of diffusion as a result of the normal diffusion through the volume, further reasons are possible for the change in cross sectional area such as diffusion along the surface of the sample and through the vapor phase. Furthermore, the fact that the diffusion through the volume at the exterior margin of the test pieces does not agree quantitatively with that in the interior must also be taken into consideration. (auth)

3527 AERE-Lib/Trans-506

THE EFFECT OF ADMIXTURES OF ALKALI METALS ON THE SURFACE TENSION AND MICRO-HARDNESS OF BISMUTH. I. P. Altynov. Translated by J. B. Sykes from Doklady Akad. Nauk S.S.S.R. 93, 845(1953). 3p.

An investigation of the dependence of the surface tension and the microhardness of bismuth on the concentration of admixtures of sodium and potassium was carried out. Results seemed to indicate that there is a definite relationship between the surface tension and the microhardness of a given admixture of sodium or potassium with bismuth. (C.W.H.)

3528

WELDING TYPE 347 STAINLESS STEEL FOR 1100°F TURBINE OPERATION. R. M. Curran and A. W. Rankin (General Electric Co., Schenectady, N. Y.). Welding J. (N.Y.) 34, 205-13(1955) Mar.

Sound welds can be produced in Type 347 stainless steel using an electrode with a ferrite content in the range of 1 to 4% and with the chemical composition balanced. The use of a 1925°F postweld treatment on welds made with such electrodes results in an appreciable increase in their resistance to embrittlement caused by long-time exposure to elevated temperature. Highly restrained austenitic weldments can be heat treated successfully in the range of 1900 to 2000°F provided a rapid heating rate is used. The long-time, high-temperature rupture strength of low-ferrite welds heat treated at 1925°F is comparable with the corresponding long-time, high-temperature strength of Type 347 base material and Type 347 welds made with the usual commercial compositions. (auth)

3529

PRACTICAL HARD FACING WITH FUSED SELF-FLUXING METALLIZED COATINGS. Harvey S. Miller (New England Hard Facing Co., Brookline, Mass.). Welding J. (N.Y.) 34, 214-19(1955) Mar.

Metallizing techniques are described involving the preparation of surface, spraying of deposit, fusing of deposit, and finishing. (auth)

3530

WELDABILITY OF WROUGHT HIGH-ALLOY MATERIALS. R. P. Culbertson (Haynes Stellite Co., Kokomo, Ind.). Welding J. (N.Y.) 34, 220-30(1955) Mar.

Development work has been centered on the joining and forming of alloys capable of resisting corrosion, high-temperatures plus oxidation, stresses, and mechanical shocks. The procedures for joining and the properties to be expected of weld joints in these alloys are discussed. Tests were made with nickel–molybdenum alloys, nickel–molybdenum–chromium alloys, cobalt–chromium–tungsten–nickel alloys, and N-155, an iron-base alloy with large percentages of chromium, nickel, and cobalt. These were welded by the submerged arc, inert-gas-shielded arc, and metallic-arc methods. The properties of the weld joints and the weld metal were satisfactory and fell within acceptable limits for alloys of this type. All of the alloys listed will produce weld joints meeting the minimum tensile requirements for the parent metal. The alloys tested have characteristics of the austenitic type and, generally speaking, can be welded by all of the methods common to the austenitic stainless steels. Certain of the alloys, however, exhibit characteristics that are peculiar to that alloy composition during welding and fabricating operations. Nickel–molybdenum alloys, for example, are subject to stress-cracking in the hot-short range and are the most critical of the alloys in this respect. Nickel–molybdenum–chromium and cobalt–chromium–tungsten–nickel alloys are subject to work-hardening during forming operations. These alloys, however, are not as susceptible to stress cracking during welding of restrained components as are the nickel–molybdenum alloys. N-155 alloy is subject to microfissuring if proper welding techniques are not used. All of these alloys can be welded satisfactorily when proper procedures are followed. (auth)

3531

THE FLASH WELDING OF COMMERCIAL MOLYBDENUM. PART I. TEMPERATURE DISTRIBUTION DURING PARABOLIC FLASHING OF ½-IN. SINTERED-AND-WROUGHT MOLYBDENUM RODS. Ernest F. Nippes and Wen H. Chang (Rensselaer Polytechnic Inst., Troy, N. Y.). Welding J. (N. Y.) 34, 132s-40s(1955) Mar.

A study has been made of the effects of clamping distance and platen acceleration on the temperature distribution during parabolic flashing of ½-in. diam sintered-and-wrought molybdenum rods. The experimental procedure of measuring the temperatures by means of thermocouples is described. The resulting temperature distributions are interpreted on the basis of the thermal conditions prevailing in the specimens as influenced by clamping distance and platen acceleration. The experimental results are compared with and, in general, substantiated by the findings of a microscopic examination of the as-flashed specimens. It is concluded

that the parabolic flashing of molybdenum consists of two stages divided approximately at the critical burn-off of 0.2 in./specimen. In the first stage, the temperature of a point a given distance from the flashing interface increases with increasing burn-off, whereas in the second stage the point assumes a constant temperature, resulting in a stabilized temperature distribution along the specimen. The gradient of this stabilized temperature distribution, which governs the width as well as the plasticity of the recrystallized zone, is steeper the shorter the clamping distance and the higher the platen acceleration. (auth)

3532

TEMPER BRITTLENESS OF PRESSURE VESSEL STEELS. Leonard D. Jaffe (California Inst. of Tech., Pasadena). Welding J. (N.Y.) 34, 141s-52s(1955) Mar.

Temper brittleness is an embrittlement of carbon and low-alloy steels arising from exposure to temperatures above 700°F but below those at which austenite forms. It is characterized by a rise in the temperature of transition from brittle to ductile failure, with no change in strength or hardness. The severity of temper brittleness in the low-carbon pressure vessel steels commonly used in the as-rolled or normalized condition is generally not appreciable, and no failures from this source have been reported. The effect may be more severe in quenched and tempered low-alloy steels, particularly those containing manganese, chromium and, to a lesser extent, nickel. (auth)

3533

PRODUCTION OF ZIRCONIUM ALLOYS BY CONSUMABLE ELECTRODE ARC MELTING. R. A. Beall, J. O. Borg, and H. L. Gilbert (Bureau of Mines, Albany, Oreg.). J. Electrochem. Soc. 102, 187-92(1955) Apr.

The technique and advantages of consumable electrode arc melting and remelting in the production of zirconium alloys are discussed. Descriptions of the equipment and conditions of operation involved in double melting are given. Discussion of homogeneity, purity, and effective yield is included. (auth)

3534

POROSITY AND PERMEABILITY CHANGES DURING THE SINTERING OF COPPER POWDER. G. Arthur (Atomic Energy Research Establishment, Harwell, Berks, England). J. Inst. Metals 83, 329-36(1955) Mar.

Porosity and permeability measurements have been made on copper powders sintered in hydrogen for periods up to 100 hr at 1000°C. The effects of particle shape and size were investigated by using electrolytic (angular) and atomized (spherical) powders in the size ranges −240, +300, and −300 mesh. By employing a method involving impregnation of the specimens with xylene, both the interconnected (ϵ_i) and the closed (ϵ_c) porosities were determined. (auth)

3535

POINT DEFECTS AND THE RELEASE OF ENERGY FROM DEFORMED NICKEL. J. F. Nicholas (Univ. of Melbourne, Australia). Phil. Mag. (7) 46, 87-97(1955) Jan.

A plastically deformed specimen of nickel is assumed to consist of an assembly of spherical 'grains' each of which contains a uniform distribution of point defects. On this model, a calculation is made of the rate of evolution of energy when such a specimen is heated at a uniform rate. The result is compared with experimental data, and it is shown that the model adequately explains a part of the evolution of energy at low temperatures. The activation energy for migration of the defects is calculated to be 1.0 ev (23 kcal/mole). It is suggested that the defects are probably vacancies, but the possibilities that they are interstitials or vacancy pairs are not excluded. On the vacancy hypothesis, the energy stored per vacancy is about 1.6 ev. (auth)

3536

THE EXAMINATION OF OXIDE FILMS BY REFLECTION ELECTRON MICROSCOPY. J. S. Halliday and W. Hirst (Associated Electrical Industries, Ltd., Aldermaston, Berks, England). Proc. Phys. Soc. (London) B68, 178-81 (1955) Mar.

A reflection electron microscopic investigation of the change in surface topography of metals when oxidized is presented. Results show that topographical differences in oxide films exist which satisfactorily account for the different mechanical properties. (C.W.H.)

3537

DILATOMETRIC STUDY OF THE $\alpha \rightleftharpoons \sigma$ TRANSFORMATION IN IRON–CHROMIUM ALLOYS. Paul Bastien and Gilles Pomey. Compt. rend. 240, 866-8(1955) Feb. 21. (In French)

The slowness of $\alpha \rightleftharpoons \sigma$ transformations is such that a dilatometric study can frequently be related to states out of equilibrium. A dilation-temperature diagram is established for several metastable states which provides for the interpretation of all dilatometric curves encountered in practice. (tr-auth)

3538

FIBER METALLURGY. A. G. Metcalfe, C. H. Sump, and W. C. Troy (Armour Research Foundation, Chicago). Metal Progr. 67, No. 3, 81-4(1955) Mar.

Bodies of novel properties may be prepared when metal fibers or filaments are used as raw materials for compacting and sintering a finished part. A large range of porosities is possible, combined with high strength and toughness. (auth)

3539

CHOOSING A TITANIUM ALLOY. Leonard D. Jaffe (California Inst. of Tech., Pasadena). Metal Progr. 67, No. 3, 104-8(1955) Mar.

The many alloying metals proposed for titanium have a consistent action except vanadium and aluminum. All of them have virtues. Some of the so-called interstitial elements (C, N, O, B, H) are powerful strengtheners but are equally damaging to toughness and workability. Effects of composition and heat treatment are interrelated and systematized. (auth)

3540

STRESS-CORROSION OF STAINLESS STEELS. J. J. Heger (U. S. Steel Corp., Pittsburgh). Metal Progr. 67, No. 3, 109-16(1955) Mar.

Studies of service failures and laboratory investigations have developed a better understanding of stress-corrosion. Some suggestions for preventing or minimizing it are offered, but a complete explanation of the mechanism of stress-corrosion cracking must await more fundamental information. (auth)

3541

SOME EFFECTS OF VARIATION IN THE ZINC CONTENT ON THE MECHANICAL PROPERTIES AND CORROSION RESISTANCE OF Al–Si–Cu ALLOYS. Metallurgia 51, 115-19(1955) Mar.

Additions of zinc up to 2% have no adverse effect on the tensile strength, proof stress, or ductility of the LM-4 type alloy containing either 0.04 or 0.14% magnesium in the as-cast or artificially aged conditions. Neither do they have

any adverse effect on naturally aged materials exposed for 12 months outdoors or in a high humidity room. Insofar, therefore, as this evidence is relevant to the important service properties of the material, it shows that additions of zinc up to about 2% do not adversely affect the alloy. (auth)

3542

REACTIVITY OF FRESHLY FORMED METAL SURFACES. Metallurgia 51, 119-20(1955) Mar.

Studies of the nature of freshly abraded surfaces were carried out. Attempts were made to correlate the Kramer effect with the Russell effect and with Shaw's "mechanical activation." (C.W.H.)

3543

THE PROPERTIES OF A HIGH-MANGANESE AUSTENITIC STAINLESS STEEL. G. N. Flint and L. H. Toft. Metallurgia 51, 125-9(1955) Mar.

It is shown that although in some media the corrosion-resisting properties of a stainless steel containing 18% chromium, 10% manganese, 2% nickel, stabilized with titanium, are equal to those of a titanium-stabilized 18-8 chromium-nickel steel, there are many industrial applications for which the high-manganese steel would not be suitable. The ductility and deep-drawing properties of the high-manganese steel are inferior to those of the 18-8-titanium type. (auth)

3544

DRILLING TESTS ON A TITANIUM ALLOY. RESULTS OF A PERA INVESTIGATION. Metallurgia 51, 133-6(1955) Mar.

An investigation has been carried out into factors influencing the drilling of the titanium alloy Ti-150A in order to determine the effect of point shape, helix angle, cutting speed, feed rate, and cutting fluid on the performance of high-speed steel drills. (C.W.H.)

3545

THE PHOTOMETRIC DETERMINATION OF ZIRCONIUM IN HIDUMINIUM RR.350 AND SIMILAR ALLOYS. E. C. Mills and S. E. Hermon. Metallurgia 51, 157-8(1955) Mar.

Because of the difficulties of time and expense attached to gravimetric determination of zirconium in aluminium alloys, photometric methods have been examined. A technique using alizarin-S has been devised and found satisfactory for foundry control purposes. (auth)

PHYSICS

3546 AD-10193

Victoreen Instrument Co.

IMPROVEMENT OF RELIABILITY OF CURRENT REGULATOR TUBES. QUARTERLY REPORT NO. 3 [FOR] JANUARY 1, 1953 TO MARCH 31, 1953. William C. Kaiser and Arthur J. Stokes. 27p. Contract DA-039-SC-42527.

The performance of 50-ma current regulator tubes using Mo, W, and Fe wire is investigated.

3547 AD-43132

Cook Research Labs. Div., Cook Electric Co.

PRESSURE ELEMENTS UTILIZING PRESSURE SENSITIVE RESISTORS. INTERIM PROGRESS REPORT NO. PR 34-2. COVERING PERIOD JUNE 15, 1953—NOVEMBER 15, 1953. Leo G. Killian, comp. May 3, 1954. 71p. Contract DA-36-039-sc-42688.

The determination of the feasibility of using pressure-deflection elements in some type of resistance transducer as a means of indicating atmospheric pressure to a high degree of accuracy and with excellent reliability is presented. The results of a survey of the field of pressure deflection elements, considering the various forms of these elements and the characteristics of the materials of which they can be made are presented. The results of laboratory investigation of methods of creating a strain-sensitive resistance unit by establishing chains of conducting particles in plastic resins are presented. The methods of motion-resistance conversion are reviewed. (auth)

3548 AD-47919

Ohmart Corp.

STUDY AND DEVELOPMENT OF NUCLEAR BATTERIES. QUARTERLY SCIENTIFIC REPORT NO. 6 [COVERING THE PERIOD JANUARY 15 THROUGH MARCH 31, 1954]. 43p. Contract AF 33(616)-172.

Work on the preparation and testing of electrodes and plans and equipment for future investigations are discussed. An α battery, powered with one curie of Po, was taken apart and examined after ten months operation. The physical appearance of the Pb electrode was improved by radiation exposure. Batteries were built for the purpose of studying the effect of source geometry on output current, testing components, and making temperature coefficient measurements. A series of standard temperature coefficient tests for the batteries were devised, and a controlled-atmosphere box was constructed to provide an inert atmosphere for the preparation of active metal electrodes. (C.H.)

3549 AD-48094

Ohmart Corp.

STUDY AND DEVELOPMENT OF NUCLEAR BATTERIES. QUARTERLY SCIENTIFIC REPORT NO. 7 [COVERING THE PERIOD APRIL 1 TO JUNE 30, 1954]. 48p. Contract AF 33(616)-172.

A number of active metal electrodes were prepared and studied. Some of these electrodes were incorporated into batteries which were tested. A thermostatically controlled oven, capable of holding nine nuclear batteries at a time, was constructed for use in temperature coefficient measurements. (For preceding period see AD-47919). (C.H.)

3550 AD-51362

Ohmart Corp.

STUDY AND DEVELOPMENT OF NUCLEAR BATTERIES. QUARTERLY SCIENTIFIC REPORT NO. 8. [1954]. 51p. Contract AF 33(616)-172.

Work on the preparation of potassium, CuO/Cu, and crystal electrodes is discussed. New batteries with different electrodes were subjected to different evacuation and filling gases in an attempt to determine the best electrode composition and filling techniques. Equipment for the measurement of temperature coefficient was modified, and results of measurements are reported. (For preceding period see AD-48095.) (C.H.)

3551 AERE-Inf/Bib-95

Atomic Energy Research Establishment, Harwell, Berks (England)

ACTINIUM. A BIBLIOGRAPHY OF UNCLASSIFIED AND DECLASSIFIED ATOMIC ENERGY PROJECT REPORTS AND REFERENCES TO THE PUBLISHED LITERATURE (1906-1953). R. W. Clarke. Aug. 1954. 24p.

3552 AERE-Lib/Trans-505

ON THE RELATION BETWEEN THE RATIO OF THE HEAT OF FUSION TO THE TEMPERATURE OF FUSION AND THE ATOMIC NUMBER OF THE ELEMENT. A. A. Bochvar and G. M. Kuznetsov. Translated by J. B. Sykes from Doklady Akad. Nauk S.S.S.R. 98, 227(1954). 2p.

The entropy of fusion is shown to be a periodic function of the atomic number of the element. The largest entropy of fusion belongs to the elements of the fluorine subgroup. (M.P.G.)

3553

POLARIZATION IN THORIUM OXIDE CRYSTALS. W. E. Danforth (Barton Research Foundation of the Franklin Inst., Swarthmore, Penna.). J. Chem. Phys. 23, 591-2(1955) Mar.

Experiments with single thorium oxide crystals in the low-oxygen state which results from treatment at high temperature in vacuum are reported. The crystals were mounted in a vacuum furnace, which was maintained at 1280°C. The procedure was to impress a resistance-limited current upon the crystal and observe the resulting potential difference. (C.W.H.)

3554

APPARATUS FOR MEASURING THE THERMAL CONDUCTIVITY OF METALS IN VACUUM AT HIGH TEMPERATURES. Marvin Moss (Sylvania Electric Products, Inc., Bayside, N. Y.). Rev. Sci. Instr. 26, 276-80(1955) Mar.

The method of determining the thermal conductivity of a metal with this apparatus consists, essentially, of measuring both the axial temperature gradient and the transfer of heat under steady state conditions in a thermally shielded cylindrical rod of the metal which is heated at one end and cooled at the other. The objective was to make precise determinations of conductivity without reliance on previously established data for standard metals. In certain respects the apparatus embodies simplification of, and improvement over, other equipment of this type. A calorimetric measurement of heat flow constitutes a distinct advantage of the instrument both as to its simplicity and the fact that it supplies the data necessary for a direct rather than a comparative evaluation of thermal conductivity. Other features include vacuum operation and special instrumentation to facilitate the measurement of temperature differences. Tests have been made on Ni, Zr, and a Zr–37%Sn alloy from room temperature up to the range between 500 and 700°C. Where comparison is possible the results are in close agreement with some of the most accurate published data of this type. (auth)

3555

THE DYNAMICS OF BINARY HYDRIDES. H. C. Longuet-Higgins and D. A. Brown (Univ. of London). J. Inorg. and Nuclear Chem. 1, 60-7(1955) Mar.

The vibrational frequencies of the hydrides XH_2, XH_3, and XH_4 have been calculated on the assumption that the electron distribution in each molecule is spherical and rigid. The twisting frequencies ν_2 of the XH_4 molecules are shown to be determined by the formula $4\pi^2 \nu_2^2 = 9\sqrt{6e^2/32mr_0^3}$ where e and m are the charge and mass of the proton and r_0 the equilibrium XH distance. This equation predicts the twisting frequencies of CH_4, SiH_4, GeH_4, and NH_4^+ within 5 per cent. The other frequencies in these molecules involve the electron density ρ_H at a proton. Using one frequency to determine this parameter, the others are found to be in moderate agreement with experiment. (auth)

3556

THE DETACHMENT OF ELECTRONS FROM NEGATIVE HYDROGEN IONS BY IMPACT WITH NEUTRAL ATOMS. D. W. Sida (Univ. Coll., London). Proc. Phys. Soc. (London) A68, 240-3(1955) Mar.

Born's approximation is applied to calculate the cross section for detachment of an electron from a negative ion of hydrogen in collision with a helium atom as a function of the energy of the ion. The results are compared with observed data and show agreement to within a factor of two or so over an energy range from 100 to 20,000 ev. (auth)

AEROSOLS

3557 TT-505

INVESTIGATION INTO THE PHYSICAL PROCESSES OF THE SO-CALLED ELECTRICAL GAS PURIFICATION PROCESSES. PART I. ON THE MAXIMUM CHARGE OF SUSPENDED PARTICLES. (Untersuchungen Über Die Physikalischen Vorgänge Bei Der Sogenannten Elektrischen Gasreinigung. I. Teil. Über Die Maximale Aufladung Von Schwebeteilchen). R. Landenburg. Translated by D. A. Sinclair from Ann. Physik (5), 4, 863-97(1930). 31p.

The charging of suspended particles of 10^{-3} to 10^{-5} cm radius in the corona discharge of a negatively charged wire against a grounded wall, in general, is represented by a formula. For a low current intensity (approximately 10^{-4} amp per glow point, approximately 10^{-4} amp per meter of wire) and hence comparatively low field intensity in most of the discharge space, the charge on the small particles is larger than that given by this formula and can be represented approximately by a formula which can be derived theoretically from the charge of the particles due to the diffusion of ions in the air. (C.H.)

3558

INERTIAL IMPACTION OF AEROSOL PARTICLES ON CYLINDERS. J. B. Wong, W. E. Ranz, and H. F. Johnstone (Univ. of Illinois, Urbana). J. Appl. Phys. 26, 244-9(1955) Feb.

The inertial impaction of aerosol particles on cylinders was investigated to determine the relationship between the efficiency of impaction and the inertial parameter, the Reynolds number of flow, and the effect of interception. The impaction of sulfuric acid aerosols of nearly uniform size ranging from 0.6 to 1.4 microns diameter, on two platinum wires, 29 and 83 microns diameter, and two tungsten wires, 53 and 106 microns diameter, was measured at several velocities of flow past the wires. Reynolds numbers ranged from 13 to 330. For values of the square root of the inertial parameter $\Psi^{1/2}$ below 1.4, the experimental efficiencies of impaction agree with those predicted by Langmuir and Blodgett for potential flow and by Landahl and Herrmann for a Reynolds number of 10. The experimental values are higher than the calculated values for $\Psi^{1/2}$ greater than 1.4. The theoretical prediction that a critical value of $\Psi^{1/2}$ exists at approximately ¼, below which inertial impaction does not occur, was verified. (auth)

COSMIC RADIATION

3559

TRANSITION EFFECT AND ANGULAR DISTRIBUTION FOR INDIVIDUAL COSMIC PARTICLES. A. P. Zhdanov and P. I. Fedotov (Khlopin Radium Inst.). Doklady Akad. Nauk S.S.S.R. 100, 659-60(1955) Feb. 1. (In Russian)

3560

A COSMIC-RAY SHOWER SELECTING CIRCUIT.

A. Subramaniam (Tata Inst. of Fundamental Research, Bombay). J. Sci. Ind. Research (India) 14B, 85-6(1955) Feb.

3561

NUMBER AND ENERGY DISTRIBUTION OF PARTICLES FROM ELECTRON SHOWERS. Ch. A. d'Andlau (Ecole Polytechnique, Paris). J. phys. radium 16, 176-8(1955) Mar. (In French)

An experiment was performed with a Wilson chamber, placed in a magnetic field, to determine the energy and number distribution of electron showers produced by electrons of known energy traversing a given thickness of Pb. The fluctuations are compared with those given by the distributions of Poisson and Furry. (tr-auth)

3562

MOMENTUM SPECTRA AND POSITIVE EXCESS OF COSMIC RAY PARTICLES AT 3650 m ALTITUDE, UNDER 15 cm OF LEAD. J. Becker, P. Chanson, E. Nageotte, and P. Treille. J. phys. radium 16, 191-9(1955) Mar. (In French)

Between 2 and 30 bev/c, the differential spectrum observed beneath 15-cm Pb is of the form $p^{-1.9}$ for positive particles, and $p^{-1.8}$ for negative particles. The positive excess is therefore slightly reduced at high momenta. Between 0.4 and 0.8 bev/c, the proportion of protons is 11 ± 1%. (tr-auth)

3563

THE HIGH-PRESSURE CLOUD-CHAMBER COSMIC-RAY PROGRAMME AT LA MARMOLADA. Nature 175, 445-8(1955) Mar. 12.

A cloud chamber operating at a pressure of 78 atmospheres has been in continuous operation for 15 months at an altitude of ~6600 ft. The design and operation of the cloud chamber are described. Interesting events obtained from the photographs are summarized. (M.P.G.)

3564

HIGH-ALTITUDE COSMIC-RAY NEUTRON DENSITY AT THE GEOMAGNETIC POLE. H. A. C. Neuburg, R. K. Soberman, M. J. Swetnick, and S. A. Korff (New York Univ., N. Y.). Phys. Rev. 97, 1276-9(1955) Mar. 1.

Two successful balloon flights were launched near the geomagnetic North Pole, bearing low-energy cosmic-ray neutron detectors. The neutron maximum was found to occur at 75 ± 5 mb. A value of 161 mb was found for the mean absorption depth, L. (auth)

3565

ON THE SPECTRUM OF LOW ENERGY GAMMA RADIATION IN COSMIC RADIATION. M. Ageno, G. Cortellessa, and R. Querzoli (Istituto Superiore di Sanita, Rome). Nuovo cimento (10) 1, 453-67(1955) Mar. (In Italian)

Using a NaI crystal and a one-channel scintillation spectrometer, we have studied the energy spectrum of the ultra-soft component of the cosmic radiation at sea-level, in the open air and below 100 g/cm² concrete. This component is almost entirely made of secondary photons, mainly between 50 and 200 kev, with a prominent peak near 80 kev in the air and 90 kev below concrete. The vertical incident intensity in the air is roughly 100 quanta/min/cm²/sterad. The ultra-soft component is almost entirely isotropic, so the energy flux is about 1% of the total energy flux due to the cosmic radiation at sea level. The discontinuity of the absorption coefficient at the K critical absorption edge of Pb was put in evidence by means of absorption measurements in this element, confirming the fact that the ultra-soft component is made of photons. (auth)

3566

FURTHER EVIDENCE FOR NUCLEAR INTERACTION OF A CHARGED HYPERON ARRESTED IN PHOTOGRAPHIC EMULSION. R. H. W. Johnston and C. O'Ceallaigh (Dublin Inst. for Advanced Studies, Ireland). Nuovo cimento (10) 1, 468-72(1955) Mar. (In English)

A further example is described of the interaction at rest of a particle of protonic mass. The appearance of the interaction is that of a typical σ star of six branches. The parent particle is ejected from a star of type 23 + 1 p, and comes to rest after a range of 7 mm. Estimates of mass by two independent techniques are in agreement with each other, and are consistent with those of charged hyperons reported by other workers. (auth)

ELECTRICAL DISCHARGE

3567

THEORY OF HIGH FREQUENCY DISCHARGE IN GASES AT LOW PRESSURE. CALCULATION OF THE ELECTRON DISTRIBUTION FUNCTION. Jean Salmon (College de France, Paris). J. phys. radium 16, 210-18(1955) Mar. (In French)

Research on conditions for starting a discharge of this type requires a knowledge of the electron distribution present within the gas which can be obtained by solving the Boltzmann equation by a method of successive approximations. After an elementary study of electron motion in an oscillating field, a detailed calculation is made of the Boltzmann equation terms relative to elastic and inelastic collisions. It is shown that the speed distribution function is Maxwellian to the first order, and an equation is given for determining the corresponding electron temperature. Finally, the first-order terms are explained and a general form is given for an equation yielding the electron density. (tr-auth)

ELECTRONS

3568

ČERENKOV RADIATION FROM EXTENDED ELECTRON BEAMS. M. Danos (Columbia Univ., New York). J. Appl. Phys. 26, 2-7(1955) Jan.

The Čerenkov radiation emitted by a bunched electron beam passing along a dielectric material at a close distance is calculated for a flat beam near a plane surface, a flat beam between two plane surfaces, and for a circularly cylindrical beam within a cylindrical hole. (auth)

3569

USE OF SPACE CHARGE IN ELECTRON OPTICS. E. A. Ash (Queen Mary Coll., London). J. Appl. Phys. 26, 327-30 (1955) Mar.

The electron optical properties of a cylindrical space charge cloud are derived. The possibility of achieving a system free from either spherical or chromatic aberration by combining a space charge lens with a space charge free converging lens is examined. It is concluded that the achromatization of a thin electric or magnetic lens is possible only if the resultant action of the combination is divergent. The correction of the spherical aberration of a high quality lens, such as an electron microscope objective, is shown to be impossible on account of electron interaction effects. (auth)

GASES

3570 RDB(Cap)/TN-127

Research and Development Branch, Industrial Group, Capenhurst Works, United Kingdom Atomic Energy Authority, Capenhurst, Ches. (England)

AN ACCURATE GAS BLENDING APPARATUS FOR MIXTURES INVOLVING SMALL MOLAR CONCENTRATIONS. D. H. Brain and P. B. F. Evans. Sept. 1954. 15p. (DDC/P-107)

Accurately blended gas mixtures were required for comparison with unknown mixtures in a mass spectrometer. The range of component concentrations in the mixtures was from 50 per cent to 0.2 per cent. The method of blending consists of completely transferring accurately measured quantities of pure component gases to a common mixing vessel. The pressure of each component gas in a calibrated volume is measured and the gas is transferred to the mixing vessel. This is the mass spectrometer sample vessel. Gas is transferred through sintered silicon-carbide discs immersed in mercury. Any number of component gases may be included in one mixture. The accuracy of blending was shown to be within ±0.33% of 0.01 molar concentrations, ±1.0% of 0.003 and ±5.0% of 0.002 molar concentrations. (auth)

3571 TT-508

EXCHANGE OF VIBRATIONAL AND TRANSLATIONAL ENERGY BETWEEN EXCITED IODINE MOLECULES AND RARE GASES. (Austausch Von Schwingungs-und Translationsenergie Zwischen Angeregten Jodmolekülen Und Edelgasen). Fritz Rossler. Translated by D. A. Sinclair from Z. Physik 96, 251-67(1935). 17p.

The quenching and transfer probabilities of vibration and rotation are determined for all gases. The rotational and vibrational transfers are found to be of the same order of magnitude. The yield per collision presupposes an effective cross section about 25 times as great as the kinetic theory cross section. Thus the yield for the case of fluorescence transfer is greater by several powers of 10 than that of sound dispersion and vibrational activation. A hypothesis is suggested by which it might be possible to interpret the variations in the effect with the mass using sound dispersion and vibrational activation on the one hand and fluorescence investigations on the other. The quenching of fluorescence due to collisions with the rare gas atoms leads to a simple interpretation. (auth)

3572 TT-518

KINETIC EQUATIONS IN THE THEORY OF SUPER-FLOW. (Kineticheskie Uravneniia V Teorii Sverkhtekuchesti). N. N. Bogoliubov. Translated by G. Belkov from Zhur. Eksp. i Teoret. Fiz. 18, 622-30(1948). 16p.

The present paper is devoted to a study of the interaction between elementary excitations of a weakly interacting nonideal Bose-Einstein gas based on a consideration of terms of the third order in the Hamiltonian system. With the usual procedure of calculating the probabilities of transition, a kinetic equation is obtained for elementary excitations. Its equilibrium solutions are considered, and a corresponding H-theorem is established. (auth)

3573

THE COMPRESSIBILITY OF GASES AT HIGH TEMPERATURES. X. XENON IN THE TEMPERATURE RANGE 0° TO 700°C. AND THE PRESSURE RANGE 8 TO 50 ATMOSPHERES. E. Whalley, Y. Lupien, and W. G. Schneider (National Research Council of Canada). Can. J. Chem. 33, 633-6(1955) Apr.

The virial coefficients of xenon have been measured in the temperature and pressure range described. The results are compared with previous measurements. (auth)

INSTRUMENTS

3574 AECU-3008

Crocker Lab., [Univ. of Calif., Berkeley]

CURRENT INTEGRATOR. [REPORT] 60-68. Kenneth D. Jenkins. Apr. 3, 1950. 9p. Contract [W-7405-eng-48].

The design of a capacitor charging current integrator is described. The errors inherent in the instrument are listed, and methods of minimizing the errors are discussed. An integrator was built for the positive ion beam from a 60-in. cyclotron. The instrument covers the range of 10^{-4} to 10^{-8} amp and acts as its own amplifier. A circuit diagram and parts list are included. (M.P.G.)

3575 AECU-3009

Crocker Lab., Univ. of Calif., Berkeley

MAGNET CURRENT REGULATOR AND METERING CIRCUIT. [REPORT] 60-143. Kenneth D. Jenkins. May 1, 1952. 2p. Contract [W-7405-eng-48].

A modification to a magnet current regulator is briefly described. The current is held constant to better than 1 part in 10,000 for over an hour. For circuit diagrams and a more complete description, refer to AECU-3010. (M.P.G.)

3576 AECU-3010

Crocker Lab., Univ. of Calif., Berkeley

MAGNET CURRENT REGULATOR. [REPORT] 60-164. Kenneth D. Jenkins. Mar. 11, 1953. 8p. Contract [W-7405-eng-48].

A cyclotron magnet current regulator with a design stability of 1 part in 10,000 is described. Circuit diagrams are presented for the individual components which include an input d-c chopper, preamplifier, phase inverter, modulator, phase detector, and voltage-regulated power supply. (M.P.G.)

3577 CERN-PS/PD-3

[European Organization for Nuclear Research. Geneva]

PRINCIPE DE MONTAGE D'UN MESUREUR DE CHAMP EMPLOYANT UN FIL DE BISMUTH COMME PARTIE SENSIBLE. (Measuring Instrument for a [Magnetic] Field using a Bismuth Wire as the Sensitive Element). P. Denis. Feb. 1955. 7p.

A method is proposed for measuring the intensity of magnetic fields by observing the change of resistivity in a Bi wire. The sensitivity of such an instrument is considered at various temperatures, and a circuit is described which provides direct-reading indications. (K.S.)

3578 WADC-TR-53-194

Rosemount Aeronautical Labs., Univ. of Minn.

[FREE AIR TEMPERATURE MEASUREMENTS]. DESIGN AND PERFORMANCE STUDIES FOR IMPROVED MULTIPLE-SHIELDED TOTAL TEMPERATURE PROBES. Frank D. Werner, Robert E. Keppel, and M. A. Bernards. Apr. 1953. 81p. Contract AF 33(038)-30036. (AD-27727)

Gas temperature probes are described which have excellent performance at high temperatures and low densities. The probes are triple shielded, total temperature type probes made of platinum and rhodium alloys and are useful as high as 1500°C or more. Both thermocouple and resistance thermometer type probes are described. Approximate calculations of the errors and other performance features of these probes are valuable in displaying the important design considerations and the significant trends in the performance of the probes. These calculations and their results are outlined. Consideration is also given to moderate

and low temperature designs, for which cases, very small errors are to be expected. For a given probe design, errors depend only on the observed total temperature and pressure. Testing these probes is a very difficult problem since a highly accurate reference temperature is essential. A good solution to this problem is outlined. The heater for the test apparatus is of the storage type and may be of interest to those concerned with wind tunnel stagnation heating. Although the probes described are specifically designed for total temperature measurements, they are useful also for static temperature measurements when aspirated. Special attention in the testing program was given to proper simulation of the total temperature measuring problem for aircraft in supersonic flight. Experimental results are given. (auth)

3579

A REFLEXION ELECTRON MICROSCOPE. V. E. Cosslett and D. Jones (Cavendish Lab., Cambridge, England). J. Sci. Instr. 32, 86-91(1955) Mar.

The design, construction, and performance are described of an apparatus specially built for microscopy of solid surfaces which are illuminated by an electron beam at grazing incidence. General requirements of design are discussed as well as practical details. Special features are: a continuously variable tilt of the illuminating system from 0 to 10°; an object stage possessing several degrees of freedom; and an objective lens of long working distance which allows specimens to be examined of a size usual in metallurgy, and permits them to be subjected to heat or other treatment, since they are outside the lens pole piece. The magnification is continuously variable from ×500 to ×10,000. Electron diffraction patterns can also be obtained without changing the position of the specimen; the lens system is designed so as to minimize the distortion, rotation and chromatic errors in diffraction patterns. Typical micrographs are shown of both ferrous and nonferrous metals, and difficulties in the interpretation of reflection pictures are briefly discussed. (auth)

3580

A SIMPLE REFLEXION-TRANSMISSION STAGE FOR AN ELECTRON MICROSCOPE. K. Amboss (British Paper and Board Industry Research Assoc., Kenley, Surrey, England). J. Sci. Instr. 32, 116(1955) Mar.

Design and construction of a modified reflection-transmission stage for an electron microscope which gives the specimen five degrees of freedom are described. (C.W.H.)

3581

TWO NEW SIMPLIFIED SYSTEMS FOR THE CORRECTION OF SPHERICAL ABERRATION IN ELECTRON LENSES. G. D. Archard (Associated Electrical Industries, Ltd., Aldermaston, Berks, England). Proc. Phys. Soc. (London) B68, 156-64(1955) Mar.

Two new simplified electrostatic systems for the correction of third-order spherical aberration in electron lenses are described and related to earlier systems of Seeliger and Burfoot. Numerical examples are given in which the voltages and positioning tolerances of the various electrodes are calculated. The effects of scaling and change of electrode shape are discussed. (auth)

ISOTOPES

3582

ISOTOPES. W. M. Jones (Los Alamos Scientific Lab., N. Mex.). Ann. Rev. Phys. Chem. 5, 91-118(1954)

The enrichment, abundance, natural variations, properties, and methods for analysis of isotopes are reviewed. Applications in studies of rate processes and equilibrium systems, structure, atomic spectra and mass measurements are discussed. 210 references. (C.H.)

MASS SPECTROGRAPHY

3583 RDB(Cap)/R-8095

Research and Development Branch, Industrial Group, Capenhurst Works, United Kingdom Atomic Energy Authority, Capenhurst, Ches. (England)

ANALYSIS OF NON-CORROSIVE GASES WITH A MASS SPECTROMETER. PART I. THE POTENTIALITIES OF THE MASS SPECTROMETER FOR GAS ANALYSIS. D. H. Brain and P. B. F. Evans. July 1954. 42p. (DDC/P-84)

The potentialities of the mass spectrometer as an analyzer for small mixtures of noncorrosive gases were to be investigated with particular reference to the gases N, O, and A. In these preliminary investigations, experiments were carried out using He, Ne, CO, N_2, O_2, A, CO_2, N_2O, and SO_2. It was found possible to measure molar concentrations as low as 1% of a mixture to within ±2% of the concentration. To obtain this accuracy it is necessary to refer all gas measurements to a standard gas (A) in order to overcome variations in instrument sensitivity. Impurities can be traced down to concentrations of 25 ppm by use of a recorder. The accuracies achieved on mixtures other than N, O, and A depend upon the actual components involved. In some cases corrections have to be applied for cracking patterns and auxiliary peaks. (auth)

3584 RDB(Cap)/R-8108

Research and Development Branch, Industrial Group, Capenhurst Works, United Kingdom Atomic Energy Authority, Capenhurst, Ches. (England)

ANALYSIS OF NON-CORROSIVE GASES USING A MASS SPECTROMETER. PART II. THE DEVELOPMENT OF MEASURING TECHNIQUES. D. H. Brain and P. B. F. Evans. Sept. 1954. 19p. (DDC/P-103)

The work described was designed to investigate more accurate and reliable methods of analyzing gases with a mass spectrometer. A reliable method of measuring relative sensitivities was developed for use during early source life or for check measurements. This was incorporated in a method of absolute analysis of gas mixtures. The method is reliable before accurate values of relative sensitivities are established and gives standard deviations of 1/100 at 1% molar concentrations. A method of comparing similar gas mixtures was investigated, and it was shown to provide an accurate absolute method for analyzing gas mixtures. For absolute measurements an unknown mixture was compared with a known mixture accurately blended from pure gases. The comparative method gave accuracies of 100 ppm on molar concentrations from 1.0 down to 0.002. (auth)

MATHEMATICS

3585 AD-44789

Institute of Statistics, Univ. of N. C.

THE MOMENTS OF THE SAMPLE MEDIAN. John T. Chu and Harold Hotelling. Aug. 1954. 27p. Contract NR-042-031.

Under certain regularity conditions, the moments about its mean of the sample median tend, as the sample size

increases indefinitely, to the corresponding ones of the asymptotic distribution (which is normal). A method of approximation, using the inverse function of the cumulative distribution function, is obtained for the moments of the sample median of a certain type of parent distribution. An advantage of this method is that the error can be made as small as is required. Applications to normal, Laplace, and Cauchy distributions are discussed. Upper and lower bounds are obtained, by a different method, for the variance of the sample median of normal and Laplace parent distributions. They are simple in form and of practical use if the sample size is not too small. (auth)

3586 AD-44790

Institute of Statistics, Univ. of N. C.

THE EFFICIENCY OF THE SAMPLE MEDIAN. Harold Hotelling. Sept. 1954. 4p. Contract NR-042-031.

Calculations are presented establishing as unity but no more the least upper bound for the ratio of the mean square error in the sample median, regarded as an estimate of the population median, to the mean square deviation in the population from the population median in populations of finite variance. (C.H.)

MEASURING INSTRUMENTS AND TECHNIQUES

3587 AERE-EL/L-6

Atomic Energy Research Establishment, Harwell, Berks (England)

RADIAC INSTRUCTION COURSE—QUARTZ-FIBRE DOSIMETERS AND CHARGING UNITS. F. B. Whiting. Aug. 11, 1954. 17p.

Design and performance are described of several individual radiation dosimeters composed of an ionization chamber type of instrument and using a quartz fiber electroscope as the indicating element. Design and performance data are included for a self-contained portable charging unit for use with individual dosimeters. (C.H.)

3588 NP-5573

Servomechanisms Lab., Mass Inst. of Tech.

PULSE-AMPLITUDE ANALYSIS IN NUCLEAR RESEARCH. TECHNICAL REPORT NO. 3. Albert B. VanRennes. Jan. 15, 1955. [Includes 4 reprints.] 164p. Contract N5ori-07876.

The pulse-height analysis problem is investigated to determine specifications on stability of window width and window level in a multi-channel analyzer and to determine the effects of the statistical nature of the input data. It includes a detailed survey of equipments for measurement of pulse-amplitude spectra, including techniques involving data storage. A unified method is presented for evaluating analyzer performance through recognition that all analyzers consist of level selectors preceded by circuitry or equipment equivalent to a biased preamplifier. With this method, a system has been designed and constructed for recording pulse-amplitude data on 35-mm film and later reducing these data photoelectrically. Accuracy limitations imposed by statistical effects and cathode-ray spot size have been studied. Typical amplitude spectra obtained with this equipment are presented. (auth)

3589 NP-5574

Servomechanisms Lab., Mass. Inst. of Tech.

A-C IONIZATION DETECTOR. TECHNICAL REPORT NO. 4. David R. Whitehouse. Jan. 31, 1955. 73p. Contract N5ori-07876.

A rugged and fast ionization chamber for the detection of neutron flux in a nuclear reactor is described. The theory is developed for a rather unique type of a-c chamber utilizing the acoustic pressure generated within the ionized gas by an applied a-c field. On the basis of this theory and preliminary experiments, a neutron-sensitive chamber was designed and constructed, then tested in neutron flux. The instrument proves to be rugged and fast, but its reliability is undetermined at this time. The experimental chamber has a minimum detectable flux level of 1.5×10^7 n/cm^2/sec, a dynamic range of 20 to 1 (2000 to 1 estimated as attainable), and a time response of 2 milliseconds. (auth)

3590 TT-510

ON THE NON-FOCUSSED ČERENKOV EFFECT COUNTERS. (Sui Contatori Ad Effetto Čerenkov Non Focheggiati). M. Mando. Translated by D. A. Sinclair from Nuovo cimento 12, 5-27(1954). 27p.

An abstract of this paper appears in Nuclear Science Abstracts as NSA 8-5659.

3591

THE QUANTITATIVE DETERMINATION OF GAMMA-RAY EMITTING ELEMENTS IN LIVING PERSONS. L. D. Marinelli, C. E. Miller, P. F. Gustafson, and R. E. Rowland (Argonne National Lab., Lemont, Ill.). Am. J. Roentgenol. Radium Therapy Nuclear Med. 73, 661-71(1955) Apr.

A sodium iodide scintillation counter apparatus has been used for the determination of the gamma-ray activity of radon retained in the body of individuals who ingested or inhaled radium twenty to thirty-five years ago. For greater sensitivity, the background radiation was reduced by means of 1/4 inch lead shielding and the signal to background ratio was improved by selection of the pulse energy band. A method, based on original work by Evans, has been evolved capable of reducing the average probable error to $\pm 6 \times 10^{-8}$ grams of radium activity in the human body with an observation period of two hours. Confidence in the procedure has been established by control experiments with Na^{24} in humans and Ra^{226} in dogs. (auth)

3592

ISOTHERMAL PROCESSING OF THICK NUCLEAR EMULSIONS. Herman Yagoda (National Insts. of Health, Bethesda, Md.). Rev. Sci. Instr. 26, 263-6(1955) Mar.

A method for the processing of thick nuclear emulsions is outlined which develops the tracks of singly charged particles at the minimum of ionization without resort to a hot stage. The developing agent is introduced into the thick layer by means of a series of solutions varying in pH from 4.7 to 7.2 and of increasing reducing power. Uniform depth development is secured by allowing the last solution to diffuse out of the emulsion into water at 5°C. The processes of fixation and washing are designed to avoid resolution of surface silver grains, and to keep lateral swelling at a minimum. Turbidity resulting from residual silver iodide is reduced by means of a buffered thiourea solution. Thick unsupported emulsions can be restored to approximately their original size by leaching electrolytes from the gelatin with a series of graded alcohols. The isothermal cold processing reduces distortion and facilitates the microscopic study of preparations up to 2 mm thickness by minimizing danger of overdevelopment and production of excessive fog. (auth)

3593

PROPORTIONAL COUNTING OF CARBON DIOXIDE FOR RADIOCARBON DATING. H. R. Brannon, M. S. Taggart, Jr.,

and M. Williams (Humble Oil and Refining Co., Houston, Tex.). Rev. Sci. Instr. 26, 269-73(1955) Mar.

Determinations of naturally occurring radiocarbon have been made with proportional counters filled with carbon dioxide at pressures up to 10 atmospheres. After chemical and radiochemical purification, the sample is converted into carbon dioxide for the counter filling. Extreme purity is required of the counter filling gas to prevent electron electron attachment by impurities. Procedures are described for producing carbon dioxide of sufficient purity to provide consistent and reproducible results. A counting efficiency of 100% is obtained for C^{14} betas contained in the active volume of the counter, giving a sample counting rate for the counter used of 45 cpm for contemporary material at a filling gas pressure of 10 atmospheres. With the present background of 13.5 cpm and a counting time limit of two days, dating may be extended to a maximum age limit of 42,000 years. (auth)

3594

MEASUREMENT OF ELECTRONIC SUSCEPTIBILITIES BY MEANS OF NUCLEAR RESONANCE ABSORPTION. G. Feher and W. D. Knight (Univ. of California, Berkeley). Rev. Sci. Instr. 26, 293-4(1955) Mar.

The proton nuclear magnetic resonance is observed in two crossed capillary tubes embedded in a paramagnetic material in a constant external field. The resonance frequencies from the two capillaries depend on the respective demagnetizing factors. For Mn_2O_3 the two resonance lines are separated by 13.0 kc at 22.3 Mc, giving a mass susceptibility of 65×10^{-6} cgs, in agreement with values obtained by other methods. For a magnetic field homogeneity of about one part in 10^7 over the sample, the ultimate sensitivity of the method would be 10^{-7} to 10^{-8} susceptibility unit. Measurements can be made at low temperatures. (auth)

3595

RESOLUTION OF ALPHA-PARTICLE SPECTRA BY IONIZATION PULSE ANALYSIS OF COLLIMATED SAMPLES. D. W. Engelkemeir and L. B. Magnusson (Argonne National Lab., Lemont, Ill.). Rev. Sci. Instr. 26, 295-302(1955) Mar.

A high-resolution ion pulse analyzer has been developed for the study of alpha-decay fine structure. Alpha-particle spectra are distorted in conventional high geometry measurements by addition of ionization from excited-state radiations of the daughter atom. Covering the sample foil with electroformed nickel mesh of a few mils thickness proved to be an effective technique for collimating the alpha particles and absorbing coincident excited-state radiations. The resolution of the instrument was tested with samples of Bi^{212}, Th^{230}, and Pu^{238}. The measured intensities and particle energies are in satisfactory agreement with magnetic deflection data. Alpha peak standard deviations of 12 to 13 kev were obtained at a detection efficiency of 0.04 count per disintegration. The standard deviation due to amplifier noise alone amounted to 10 kev. (auth)

3596

X-RAY BEAM MEASUREMENT OF DISTORTION IN A MAGNET CLOUD CHAMBER. Robert Mowbray Walker (Yale Univ., New Haven, Conn.). Rev. Sci. Instr. 26, 304-5 (1955) Mar.

Apparatus previously described (Phys. Rev. 97, 1086(1955)) which was used in connection with a cloud chamber experiment at the Cosmotron, has been extended to magnet cloud chambers. Circuitry for pulsing the x-ray beam is described, and some performance results are discussed. (L.M.T.)

3597

ON THE MEASUREMENT OF THE RESTITUTION TIME OF GEIGER-MUELLER COUNTERS FOR THE GEIGER THRESHOLD. D. Blanc (College de France, Paris). Nuovo cimento (10) 1, 504-6(1955)Mar. (In French)

A method is described for measuring very short restitution times in Geiger counters, capable of a precision of 5% or better. (K.S.)

3598

MORPHOLOGICAL STUDY OF $_6C^{12}$ TRACKS IN NUCLEAR EMULSIONS. Pierre Cuer, Jean-Pierre Lonchamp, and Christiane Gegauff. Compt. rend. 240, 856-8(1955) Feb. 21. (In French)

The tracks produced by 120-Mev C^{12} in nuclear emulsions were studied for the purpose of confirming a previously proposed mechanism on the variation of track thickness for heavy nuclei (Compt. rend. 236, 70(1953)). A rapid growth in the track thickness is observed up to about 45μ, with a slower growth rate up to 140μ and beyond. (K.S.)

3599

EFFECT OF HYDROPHILIC LIQUIDS ON THE GELATIN OF PHOTOGRAPHIC EMULSIONS USED IN NUCLEAR PHYSICS. L. Vigneron, J. Genin, and R. Chastel (College de France, Paris). J. phys. radium 16, 179-82(1955) Mar. (In French)

Nuclear emulsions impregnated with water were dried in air, by vacuum or by immersion in a hydrophilic liquid such as acetone. In the latter plates it is shown that the dimensions of the α tracks undergo important disturbances which are attributed to the porous structure of a nuclear emulsion that is dehydrated in such a manner. Such a porous structure remains stable while dry, and is destroyed when the gelatin swells in H_2O. In addition, the existence of pores is confirmed by density experiments. (tr-auth)

3600

PHOTOMULTIPLIER STUDY OF SCINTILLATIONS PRODUCED IN A ZINC SULFIDE SCREEN BY α PARTICLES. J. P. Anthony. J. phys. radium 16, 182-90(1955) Mar. (In French)

A threshold detector was used to study the scintillations produced on the collector electrode of a photomultiplier tube. The decay time of scintillations produced in ZnS (Ag,Ni) is $\sim 3 \times 10^{-6}$ sec. The change in efficiency and relative response of the screen as a function of distance and α-particle energy was studied. The results are in accord with the theory of Birks. It is shown the 5311 photomultipliers are linear for pulse heights approaching the potential difference between dynodes. (tr-auth)

3601

MECHANICAL FILTER FOR THE SPECTROMETRY OF COLD NEUTRONS. M. Galula and F. Netter (Service de Physique nucleaire, C.E.N., Saclay). J. phys. radium 16, 233-4(1955) Mar. (In French)

A time-of-flight spectrometer is described for suppressing those neutrons from a pile whose energy coincides with the peak of the Maxwell distribution. The spectrometer consists of two Cd sectors rotating in the neutron beam in front of a fixed and rotating slit. Variable speed control provides for the accommodation of neutrons of varying energy. (K.S.)

3602

A NEW SAMPLE CHANGER FOR AUTOMATIC RADIOACTIVITY MEASUREMENTS. W. Bolliger and G. G. Poretti. Experientia 11, 115-16(1955) Mar. (In German)

Description of an apparatus with which a great number (31) of radioactive samples can be measured automatically. The time required for collecting a preset number of counts is also automatically registered by 31 mechanical registers. Absorptions measurements until 12 various absorbers are possible, too. (auth)

3603

DISINTEGRATION-RATE DETERMINATION BY 4π-COUNTING. PART I. B. D. Pate and L. Yaffe (McGill Univ., Montreal, Quebec, Canada). Can. J. Chem. 33, 610-32(1955) Apr.

The response probability of a 4π-counter has been examined and conditions determined for which the response probability is unity to within ± 0.1% for a range of nuclides. Variables examined have been the effect of polarization potential, discriminator bias, source location, counting rate, counter gas purity, thickness of conductor on source mount, for particles of various energies and from various modes of disintegration. (auth)

MESONS

3604

STATISTICAL THEORY OF MULTIPLE MESON PRODUCTION. Richard H. Milburn (Harvard Univ., Cambridge, Mass.). Revs. Mod. Phys. 27, 1-14(1955) Jan.

The Fermi statistical theory of multiple meson production is examined, and its application to medium-energy pion-nucleon and nucleon-nucleon collisions is discussed. Various approximate calculational procedures are described and their results compared critically. It is found, by the use of a precise integration procedure, that a rigorous relativistic inclusion of the meson rest mass is necessary if one is to draw accurate conclusions from the postulates of the theory. The consequences of isotopic spin conservation are described and tables are given for the expected distribution of charged products from both pion-nucleon and nucleon-nucleon collisions. The theory is applied to the case of pion-nucleon collisions at 1.4 Bev, and is found to predict only poorly the tentative results of recent experiments. The failure of the theory to predict nucleon-nucleon collisions is also described, and possible modifications and improvements are discussed. (auth)

3605

THE REACTION $p + p \rightarrow d + \pi^+$ AT 460 MEV. M. G. Meshcheryakov, B. S. Neganov, N. P. Boganchev, and V. M. Sidorov (Inst. of Nuclear Problems). Doklady Akad. Nauk S.S.S.R. 100, 673-6(1955) Feb. 1. (In Russian)

3606

FORMATION OF MESONS IN THE REACTION $p + p \rightarrow d + \pi^+$ IN THE RANGE 510 TO 660 MEV. M. G. Meshcheryakov and B. S. Neganov (Inst. of Nuclear Problems). Doklady Akad. Nauk S.S.S.R. 100, 677-9(1955) Feb. 1. (In Russian)

3607

FORMATION OF π^0 MESONS BY PROTONS OF 670 MEV ENERGY ON NUCLEI OF VARIOUS ELEMENTS. A. A. Tyapkin, M. S. Kozodaev, and Yu. D. Prokoshkin (Inst. of Nuclear Problems). Doklady Akad. Nauk S.S.S.R. 100, 689-92(1955) Feb. 1. (In Russian)

The yield of γ quanta from π^0 meson decay was determined for the reaction of 670-Mev protons on D, Li, Be, B, C, Al, Cu, Cd, Sn, and Pb. Yields at angles of 0 to 180° are graphed in relation to the atomic weight, and the relation is analyzed. (G.Y.)

3608

AN ESTIMATE OF THE MEAN LIFETIME OF THE θ^0-PARTICLES. D. I. Page (Univ. of Manchester, England). Phil. Mag. (7) 46, 103(1955) Jan.

An estimate of the mean lifetime of θ^0 particles has been made. From samples of V° decays 14 events were selected which satisfied criteria for θ^0 particles. An analysis of actual and potential times of flight gives the lifetime as $\tau = (0.7^{+0.3}_{-0.2}) \times 10^{-10}$ sec. Combining this value with all previously published results, the weighted mean value becomes $\tau = (1.5^{+0.4}_{-0.3}) \times 10^{-10}$ sec. (M.P.G.)

3609

PHOTOPRODUCTION OF NEUTRAL PIONS IN HYDROGEN. p-γ COINCIDENCES. R. L. Walker, D. C. Oakley, and A. V. Tollestrup (California Inst. of Tech., Pasadena). Phys. Rev. 97, 1279-82(1955) Mar. 1.

This paper reports measurements of the differential cross section for photoproduction of neutral pions in hydrogen at energies 300, 400, and 450 Mev, at center-of-momentum angles of 70 to 150°. One decay photon from the neutral pion is observed in coincidence with the recoil proton, whose energy and angle are measured to define the photon energy. The results obtained by this method are in good agreement with more accurate measurements obtained recently by the method of observing only the recoil proton. (auth)

3610

PHOTOPRODUCTION OF NEUTRAL PIONS IN HYDROGEN. MAGNETIC ANALYSIS OF RECOIL PROTONS. D. C. Oakley and R. L. Walker (California Inst. of Tech., Pasadena). Phys. Rev. 97, 1283-91(1955) Mar. 1.

The photoproduction of neutral pions from hydrogen has been studied by counting the recoil protons with a magnetic spectrometer and scintillation counters. The process has been studied between photon energies of 260 and 450 Mev and between center-of-momentum pion angles of 70 and 153°. The excitation functions show a resonance type shape with maxima at about 320 Mev. Angular distributions are analyzed in the form $A + B\cos\theta + C\cos^2\theta$ in the center-of-momentum system. The coefficient B, which gives the front-back asymmetry, is small at all energies; and the ratio $-A/C$ is 1.22 ± 0.10 at all energies between 295 and 450 Mev. The maximum cross section at 90° in the c.m. system is 26×10^{-30} cm²/steradian for 320-Mev photons. The total cross section divided by the square of the c.m. photon wavelength has a maximum near 340 Mev, and drops by nearly a factor of two at 450 Mev. These results are consistent with magnetic dipole and electric quadrupole absorption leading to a resonant state of the pion-nucleon system of angular momentum $3/2$ and isotopic spin $3/2$. (auth)

3611

NUCLEAR ABSORPTION OF A FAST CHARGED HYPERON. M. M. Block and D. T. King (Naval Research Lab., Washington, D. C.). Phys. Rev. 97, 1415-16(1955) Mar. 1.

Experimental evidence for the following reaction schemes has been reported: (1) $\pi + N \rightarrow Y + K$, (2) $K + N \rightarrow Y + \pi$, and (3) $N + N \rightarrow Y + K + N$, where N, Y, and K represent nucleon, hyperon, and heavy boson, irrespective of charge. This note suggests the existence of a further reaction which is the absorption analog of (3), namely, $Y + N \rightarrow N + N + K$. (auth)

3612

PHENOMENOLOGICAL STUDY OF THE NEW PARTICLES. Λ-PARTICLES AND Λ-NUCLEI. R. Gatto (Univ. of Rome).

Nuovo cimento (10) 1, 372-93(1955) Mar. (In English).

Some questions on the new unstable particles are discussed, with the deliberate avoidance of any very specific assumption. The slowness of the decay rates imposes, by semi-qualitative arguments, relevant restrictions. We try to develop fully such a viewpoint, and conclusions are drawn about production processes, about processes in which the excited hyperon takes part, and about processes which occur after the capture of a heavy meson or a hyperon by a nucleus. The important question is to know what other independent assumptions must be added to that of the long mean lives to get a consistent scheme. The Λ^0 nuclei are analyzed from a more phenomenological standpoint. The implications of this analysis on the high spin model of the Λ^0 are discussed. The arguments are not strictly quantitative, however their possible failure would be in any case an interesting conclusion. The possible composite nature of the new particles is briefly discussed in connection with the role of weak interactions and with the possible validity of charge independence at production. Charge independence at decay is not expected to hold and this question is discussed in the case of the θ^0 meson. (auth)

3613

MODELS OF HYPERONS. H. Enatsu and C. Ihara (Kyoto Univ., Japan). Nuovo cimento (10) 1, 394-402(1955) Mar. (In English)

Methods of mixed fields are extended to the case of hyperons. In order to take into account a new particle (Y particle) which decays into a Λ particle and a π meson, a set of the so-called strong interactions between hyperons and mesons is assumed. Then the Λ particle self-energy is calculated to the second-order terms through the use of the method of the present field theory. Some relations in which the masses of these hyperons and mesons are included are derived from the cancellation of its divergence. It is shown that their masses estimated in terms of the relations are as follows: Y ~ 2600 m_e, Λ ~ 2200 m_e, and the masses of scalar mesons which decay into two π mesons are 800 m_e and 1500 m_e. The model presented here gives results being in qualitative agreement with experiment. (auth)

3614

HYPERON EVENTS IN PHOTOGRAPHIC EMULSIONS. M. W. Friedlander, D. Keefe, and M. G. K. Menon (Univ. of Bristol). Nuovo cimento (10) 1, 482-91(1955) Mar. (In English)

Details are given of six hyperon events observed in photographic emulsions. Two of these decay at rest into protons and give Q values of 115.8 ± 1.0 Mev and 113.5 ± 1.7 Mev for the assumed decay scheme $Y^+ \rightarrow p + \pi^0 + Q$. Three others decay in flight. Two give Q values 115 ± 7 Mev and 103 ± 10.5 Mev for the decay mode $Y^+ \rightarrow n + \pi^+ + Q$. The third is in agreement with the cascade type of decay $Y^- \rightarrow \Lambda^0 + \pi^- + Q$ and has a Q = 59 ± 11 Mev. The sixth event has been interpreted as the interaction at rest of a negative hyperon. From the parent star of this hyperon there also emerges a K meson. (auth)

3615

UNUSUAL EVENT PRODUCED BY COSMIC RAYS. E. Amaldi, C. Castagnoli, G. Cortini, C. Franzinetti, and A. Manfredini (Univ. of Rome). Nuovo cimento (10) 1, 492-500 (1955) Mar. (In English)

The authors describe an event consisting of two stars of about 5 and 1 to 2 bev energy. The probable value of the number of accidental space coincidences that one expects to observe in the scanned volume is about 4×10^{-4}. This value, although it does not allow us to exclude an accidental process, justifies the consideration of interpretations in terms of some physical process. Special attention is devoted to the production, capture and annihilation of a negative proton. (auth)

3616

INTERACTION OF π MESONS IN PHOTOGRAPHIC PLATES. L. Ferretti and E. Manaresi (Univ. of Bologna, Italy). Nuovo cimento (10) 1, 512-16(1955) Mar. (In English)

Elastic scattering cross sections, mean free paths, and the distribution of scattering events for 17-Mev (mean) $\pi \pm$ mesons are studied in Ilford G5 plates within the energy range of 0 to 20 Mev. (K.S.)

MOLECULAR PROPERTIES

3617

ON THE STATE OF SOLID HYDROGEN. Kazuhisa Tomita (Mathematical Inst., Oxford). Proc. Phys. Soc. (London) A68, 214-28(1955) Mar.

Co-operative appearance of the rotation of hydrogen molecules in the solid phase is described using a semi-classical theory. The order of magnitude of the restriction to the rotation which is experienced by a molecule at the lowest temperature is estimated to be about 4°K using several different types of experiments, and the results are in reasonable agreement with each other. For the case of pure ortho-hydrogen a calculation of the potential energy and the anisotropy based on intermolecular forces is carried out in the appendix. (auth)

NUCLEAR PHYSICS

3618

NUCLEON-NUCLEUS POTENTIAL AT HIGH ENERGIES. E. Clementel (Univ. of Padova, Italy). Nuovo cimento (10) 1, 509-11(1955) Mar. (In English)

3619

GAMMA RAY ENERGY SPECTRUM FROM IRON BOMBARDED BY 14-MEV NEUTRONS. Satio Hayakawa (Kyoto Univ., Japan) and Ken Kikuchi (Osaka Univ., Japan). Progr. Theoret. Phys. (Japan) 12, 578-84(1954) Nov.

The energy spectrum of γ rays from Fe when bombarded by 14-Mev neutrons is calculated on the basis of the compound nucleus formalism. The cross sections for various competing processes are found to be considerably dependent upon the magnitude of temperature. We have assumed three values of a, the quantity closely related to temperature. Although they are based upon the experimental evidences of different sources none of them is found to be able to account for the experimental energy spectrum. There seems to remain a difficulty in the statistical theory pointed out by Cohe (auth)

3620

COMMENTS ON NUCLEAR MODELS. D. Ivanenko, N. Kolesnikov, and S. Larin (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 100, 37-40(1955) Jan. 1. (In Russian)

3621

THERMAL-NEUTRON-CAPTURE GAMMA RAYS AND STRUCTURE OF ATOMIC NUCLEI. L. V. Groshev (Lebede Physics Inst.). Doklady Akad. Nauk S.S.S.R. 100, 651-4(195 Feb. 1. (In Russian)

NUCLEAR PROPERTIES

3622 AD-25190

Purdue Univ.

THE EFFECT OF ELECTRIC QUADRUPOLE INTERACTIONS ON ANGULAR CORRELATIONS (thesis). Philip Brian Hemming. Jan. 1954. 46p.

Two experimental investigations were made of the influence of extranuclear fields on the directional correlation of successive nuclear radiations from the γ-γ cascade of Cd^{111}. A magnetic decoupling experiment was made in an attempt to restore partially the maximum anisotropy exhibited by an $In(OH)_3$ source by applying a magnetic field in the direction of a stationary γ-ray counter. The results revealed a small increase in the correlation with the application of the magnetic field and supported the evidence that the magnetic I–J coupling has a small effect but that most of the attenuation results from electric quadrupole interactions. A second experiment was made to determine the influence of time-dependent quadrupole interactions in a liquid source upon the directional correlation. The correlation time was varied by changing the viscosity of the source with the addition of glycerine. The attenuation was shown to be time-dependent, and a graph is included showing the influence of the viscosity on the directional correlation. A rough estimate is included of the quadrupole interaction energy. (ASTIA abst.)

3623

THE EFFECT OF FINITE NUCLEAR SIZE ON BREMSSTRAHLUNG PRODUCTION. S. J. Biel and E. H. S. Burhop (Univ. Coll., London). Proc. Phys. Soc. (London) A68, 165-72(1955) Mar.

Calculations have been made of the bremsstrahlung spectrum emitted in different directions following electron-nuclear collisions, allowing for the finite distribution of the nuclear charge. Calculations were carried out for charge distributions of the uniform sphere, spherical shell, gaussian, and exponential forms, as well as for a uniform spherical core with a distribution falling off exponentially at the surface. In each case the parameters of the distribution were chosen to agree with the elastic electron scattering data at 16 Mev. The modification of the angular distribution obtained from the Bethe–Heitler formula for a point nucleus is large for electron energies above 20 Mev. (auth)

3624

STUDIES IN INTERMEDIATE COUPLING. III. THE LITHIUM ISOTOPES. A. M. Lane (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Phys. Soc. (London) A68, 189-96(1955) Mar.

The methods of a previous paper are applied to the analysis of the reaction data on the lithium isotopes in terms of an intermediate coupling shell model of the nucleus. It is found that, to within the expected uncertainties, all of twelve data are consistent with the predictions of the model. The mean value of the intermediate coupling parameter a/K is about 3. As an incidental result, it is found that the β-decay data cannot be fitted with the old interaction mixture based on mirror transitions, but requires a new mixture based on the O^{14} Fermi transition. (auth)

3625

STUDIES IN INTERMEDIATE COUPLING. IV. FURTHER REMARKS ON THE NUCLEI ^{13}C AND ^{13}N. A. M. Lane (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Phys. Soc. (London) A68, 197-203(1955) Mar.

The results reported in a previous paper on the nuclei C^{13} and N^{13} are extended in three ways: (i) The β-decay ft-value for the allowed mirror transition has been examined in intermediate coupling and is shown to be in excellent agreement with the previous results. (ii) Some properties of the nuclei have been recalculated with different assumptions about the central force between nucleons. It is found that the previous results are not very much changed, even when the central force mixture is quite severely modified. (iii) Some discussion is given about the even parity states of C^{13} and N^{13}. In particular the application of the "unique parent" concept to these states, and its justification, is considered. (auth)

3626

THE SPIN, ENERGY AND LIFETIME OF ^8Be. P. B. Treacy (Australian National Univ., Canberra). Proc. Phys. Soc. (London) A68, 204-13(1955) Mar.

Coincidences are used in studying the $B^{11}(p,\alpha)Be^8(\alpha)He^4$ reaction to infer directional correlations between successively emitted α particles. From this the spin of the ground state of Be^8 is found to be zero and its break-up energy 90 ± 5 kev. The absence of any measurable loss of kinetic energy in the Be^8 nucleus when recoiling into a dense material enables an upper limit to be placed on its half life of 4×10^{-15} sec, which confirms the assignment of zero spin. (auth)

3627

THE NUCLEAR SPIN AND MAGNETIC MOMENT OF TERBIUM 159. J. M. Baker and B. Bleaney (Clarendon Lab., Oxford). Proc. Phys. Soc. (London) A68, 257-9(1955) Mar.

The nuclear spin of Tb^{159} was confirmed as $\frac{3}{2}$, and the nuclear magnetic moment was found to be 1.5 ± 0.4 nm. (L.T.W.)

3628

ENERGY LEVELS OF LIGHT NUCLEI. V. F. Ajzenberg (Boston Univ., Mass.) and T. Lauritsen (California Inst. of Tech., Pasadena). Revs. Mod. Phys. 27, 77-166(1955) Jan.

Currently available experimental information on the location and properties of energy levels of the light nuclei from He^5 to Ne^{23} is summarized. (K.S.)

3629

MAGNETIC SHIELDING OF NUCLEI IN MOLECULES BY A VARIATIONAL METHOD. James F. Hornig and Joseph O. Hirschfelder (Univ. of Wisconsin, Madison). J. Chem. Phys. 23, 474-6(1955) Mar.

The accurate measurement of nuclear magnetic moments requires a calculation of the magnetic field at the nucleus arising from the orbital motions of the electrons in the external magnetic field. In this note a solution of the "magnetic shielding effect," using the quantum-mechanical variation principle, is outlined. Since all results are in terms of ground-state wave functions, such an approach may facilitate a purely theoretical evaluation of shielding constants. As a variation function, a function of the type suggested by Hylleraas and Hassé is applied successfully to calculation of polarizabilities. (auth)

3630

NUCLEAR SPECIES. H. E. Huntley. New York, St. Martin's Press, Inc., 1954. 193p.

The systematics of nuclear properties and structure as a

whole are surveyed with the view of providing some insight concerning general rules affecting the nuclear species as a group. The approach is as non-mathematical as possible without compromising accuracy or conciseness, for the benefit of the lay reader and those scientists not immediately familiar with the details modern nuclear mathematics. (K.S.)

3631

RADIOACTIVITY AND NUCLEAR STRUCTURE. I. Perlman and J. M. Hollander (Univ. of California, Berkeley). Ann. Rev. Phys. Chem. 5, 119-38(1954).

Recent studies on nuclear structure and nuclear shells, nuclear transmutation, transuranium elements and the natural radioactivities are reviewed. 97 references. (C.H.)

3632

ON THE ^{60}Ni GAMMA-GAMMA DIRECTIONAL CORRELATION FUNCTION. S. Colombo (Istituto Nazionale di Fisica Nucleare, Milan, Italy) and A. Rossi and A. Scotti (Univ. of Milan, Italy). Nuovo cimento (10) 1, 522-3(1955) Mar. (In English)

3633

FISSION YIELDS IN SPONTANEOUS FISSION OF Cf^{252}. L. E. Glendenin and E. P. Steinberg (Argonne National Lab., Lemont, Ill.). J. Inorg. and Nuclear Chem. 1, 45-8(1955) Mar.

Spontaneous fission of Cf^{252} has been investigated by radiochemical determination of the yields of fifteen fission products ranging in mass number from 90 to 143. Fission is observed to be asymmetric with some indication of fine structure in the mass distribution associated with the 82-neutron shell. Both light- and heavy-fission product groups are shifted to higher masses relative to spontaneous fission of Cm^{242}. The yield-mass curve indicates a value of 5 ± 1 for the average number of neutrons emitted per fission. (auth)

3634

CONFIGURATION MIXING AND MAGNETIC MOMENTS OF ODD NUCLEI. Akito Arima and Hisashi Horie (Univ. of Tokyo). Progr. Theoret. Phys. (Japan) 12, 623-41(1954) Nov. (cf. NSA 8-6294)

The deviations of magnetic moments of odd nuclei from the Schmidt lines are calculated by taking into account the effect of departure from the single-particle model in nuclear states caused by configuration mixing. The calculations are based upon the simple perturbation theory and the values of the deviations are estimated by adopting the two-body interaction strengths and integrals which are determined from the empirical data on pairing energies. The general trend as well as the fluctuation of the deviations of magnetic moments from the Schmidt lines are accounted for fairly well. (auth)

3635

ON THE BINDING ENERGY AND PROPERTIES OF LOWER ENERGY LEVELS OF Li^6. Masato Morita (Kobayasi Inst. of Physical Research, Tokyo) and Taro Tamura (Tokyo Univ. of Education). Progr. Theoret. Phys. (Japan) 12, 653-88(1954) Nov.

By modifying the usual shell model treatment, so as to take into account the correlation of the position coordinates of the constituent particles, the binding energy and other properties of the lower energy levels of Li^6 are calculated. Using two body central and tensor interactions, the parameters of which are adjusted to the low energy two body data, fairly good agreement with experiment is obtained for the binding energy. However, the splitting between the second excited and the ground states is far too small, because of the large cancellation of the tensor S-D interference terms, and this is reflected in the too large value of the magnetic moment of the ground state. The quadrupole moment is very small in agreement with experiment, although it might be considered as an incidental agreement. (auth)

3636

EFFECTS OF PERTURBING RADIOFREQUENCY FIELDS ON NUCLEAR SPIN COUPLING. Arnold L. Bloom and James N. Shoolery (Varian Associates, Palo Alto, Calif.). Phys. Rev. 97, 1261-5(1955) Mar. 1.

An analysis is made of double resonance experiments in which the $I_1 \cdot I_2$ interaction observable in certain nuclear magnetic resonance spectra is perturbed by a strong radiofrequency field. The problem is treated by transforming to a rotating coordinate system in which all terms in the Hamiltonian are stationary except for the weak rf field used to investigate the spectrum. Transition energies and intensities are computed in the rotating frame and the spectrum transformed back to the laboratory frame by adding a constant factor to the energy. A double-resonance experiment involving the nuclei F^{19} and P^{31} is described and the experimental results compared with those computed from the theory. (auth)

3637

TWO-BODY FORCES AND NUCLEAR SATURATION. III. DETAILS OF THE STRUCTURE OF THE NUCLEUS. K. A. Brueckner (Indiana Univ., Bloomington). Phys. Rev. 97, 1353-66(1955) Mar. 1.

The characteristics of particle motion in the nuclear medium have been examined in detail. The origin of the strong dependence of the potential energy on the nucleon momentum is discussed, and an equivalent formulation is exhibited in which a uniform and constant potential is assumed but the nucleon moves with markedly reduced mass. The determination of the potential is shown to lead to a self-consistency problem which is to some extent similar to that appearing in the Hartree method of self-consistent fields. Solution of this problem shows that the self-consistency requirements impose severe restrictions on the solution and have a strong stabilizing influence in the saturation problem. The volume energy of the nucleus has been evaluated by using two-body potentials closely equivalent to a combination of central and tensor forces which agree with the low-energy parameters and predict scattering correctly up to 90 Mev. The result agrees closely with the observed values of energy and density. The collective character of the nucleon potential is described and shown to manifest itself markedly in the excitation energy of single-particle levels where a considerable fraction of the energy is taken up in small adiabatic shifts of the states of the remaining nucleons. The origin of the surface and symmetry energy is discussed; an evaluation of these effects gives a result in good agreement with empirically derived values. The stability of the nucleus against distortion arising from the polarizing effects of the tensor force is also examined, and it is found that the nucleus shows marked stability against such distortion. (auth)

3638

THEORY OF NUCLEAR MODELS. R. J. Eden and N. C. Francis (Indiana Univ., Bloomington). Phys. Rev. 97, 1366-79(1955) Mar. 1.

The framework for a unified theory of nuclear structure is described in which the wave functions for different nuclear models are obtained by transformations on the actual nuclear wave function. This formulation provides a basis for ex-

plaining the success of weak-coupling models of the nucleus and showing that they are not in conflict with the assumption that nucleons have very strong mutual interactions. The explanation lies in the fact that only in certain circumstances can the "particles" in a nuclear model be interpreted as nucleons. The properties which transformation operators must have to change the nuclear wave function into a model wave function and how far these properties are satisfied in practice are considered. Self-consistent equations are set up for a model having a product wave function in the particle variables, and it is shown that these equations can be solved in an approximation relevant to the problem of nuclear saturation. (auth)

3639

MAGNETIC MOMENTS OF CONJUGATE NUCLEI. J. G. Brennan (Catholic Univ. of America, Washington, D. C.) and A. B. Volkov (Univ. of Delaware, Newark). Phys. Rev. 97, 1380-6(1955) Mar. 1.

Many experimentally observed magnetic moments of conjugate (semi-mirror) nuclei deviate approximately the same amount from the Schmidt limits. It is shown that the theoretical magnetic moments provided by a simple form of the collective model are such that the difference between the deviations of a pair of conjugate nuclei is small. Those experimentally-observed exceptions to this rule where the difference between the deviations is quite large (such as I^{127}–Mo^{97}) can be explained by modifications of the collective model to include the effects of (a) shell model structure and (b) configuration admixing. In fact, the relative importance of the various dynamical features of the nucleus can be assessed, qualitatively at least, from the size and sign of the magnetic moment deviation difference of a pair of conjugate nuclei. (auth)

NUCLEAR REACTORS

3640 AERE-Lib/Trans-452

NUCLEAR REACTORS. K. Wirtz. Translated by R. J. Richardson from Naturwissenschaften 41, 269-77(1954). 18p.

The proposed regulation of atomic energy production in the Federal Republic of Germany is summarized. Reactor physics is briefly reviewed, and tables of data are presented. The problems confronting Germany in the construction of a reactor are indicated. (M.P.G.)

3641

NEUTRON SPECTRUM OF THE SACLAY PILE. M. Galula, B. Jacrot, and F. Netter, Service de Physique nucleaire, C.E.N., Saclay). J. phys. radium 16, 232-3(1955) Mar. (In French)

3642

EFFECT OF DELAYED FISSION NEUTRONS ON REACTOR KINETICS. Lawrence Baylor Robinson (Naval Research Lab., Washington, D. C.). J. Appl. Phys. 26, 52-6(1955) Jan.

A detailed treatment of reactor kinetics is given. The kinetic equations are derived from a diffusion-Fermi age model. An iterative technique and a matrix method are discussed as possibilities for obtaining solutions. The relationship between the solutions with and without delayed neutrons is pointed out. The concept of stability is discussed for the system which includes the delayed neutrons. The similarity of the treatment here to that used in other branches of mathematical physics (especially quantum mechanics) is noted. (auth)

3643

ROLE OF LIQUID METALS IN NUCLEAR POWER DEVELOPMENT. J. W. Taylor (Atomic Energy Research Establishment, Harwell, Berks, England). Research (London) 8, 102-5(1955) Mar.

Liquid metals have potential application in reactor technology as coolants and heat exchange media, carrier media for nuclear fuel, and extraction agents in processing spent fuel. The advantages and disadvantages of liquid metals as coolants are discussed, and the other applications for liquid metals are reviewed briefly. Solutions to fundamental questions on corrosion mechanisms and structure and properties of liquid metals are necessary before the full potentialities of liquid metals in nuclear power can be realized. (M.P.G.)

NUCLEAR TRANSFORMATION

3644 HEPL-35

High-Energy Physics Lab., W. W. Hansen Labs. of Physics, Stanford Univ.

PHOTONUCLEAR YIELDS OF N^{17} (thesis). Daryl D. Reagan. Feb. 1955. 56p. Contract N6onr-25116.

Yield curves of N^{17} arising from electron and x-ray bombardment have been measured for the elements oxygen, fluorine, neon, sodium, magnesium, and aluminum. Nitrogen-17 was identified by its delayed neutrons which made the measurement of low yields feasible. For the more complex reactions, the photon cross sections are very broad in their energy dependence, and increase in the region of 150 to 350 Mev. The total photonuclear cross section above 150 Mev estimated from the results reported here is of the same order of magnitude as the photomeson cross sections previously reported. (auth)

3645

CONCEPT OF PARENTAGE OF NUCLEAR STATES AND ITS IMPORTANCE IN NUCLEAR REACTION PHENOMENA. A. M. Lane (Atomic Energy Research Establishment, Harwell, Berks, England) and D. H. Wilkinson (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 97, 1199-1204(1955) Mar. 1.

The concept of fractional parentage of nuclear states is invoked to point out that many dynamical properties of nuclear systems (transition rates and level widths) are controlled by products of the coefficients of fractional parentage for common parents (the "parentage overlap") between initial and final states. Illustrations are given from a range of nuclear reactions including radiative transitions, high- and low-energy stripping, pickup, and photonuclear processes. It is particularly to be emphasized that, because of the occurrence of the coefficients of fractional parentage and certain (vector coupling) weighting factors in the expression for the transition rate, one may find reduced and radiative widths very considerably less than the "single-particle" values even though the states concerned are wholly of an independent-particle character; enhanced transitions are also possible within the same scheme. (auth)

3646

CROSS SECTIONS FOR NONELASTIC INTERACTIONS OF 14-MEV NEUTRONS WITH VARIOUS ELEMENTS. Elizabeth R. Graves and Roland W. Davis (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 97, 1205-12(1955) Mar. 1.

The multiplication of neutrons by thin spherical shells of various materials surrounding a point source of 14-Mev neutrons has been measured. A special long counter was used whose energy response is independent of neutron energy over a range of energies from about 1 to 14 Mev. The trans-

mission of primary energy neutrons through the shells has been measured with a trans-stilbene detector, and values of the inelastic collision cross sections have been derived. The quanity $\sigma_{n,\,2n}+2\sigma_{n,3n}-\sigma_c$ is calculated, where $\sigma_{n,\,2n}$ and $\sigma_{n,\,3n}$ are the cross sections for (n,2n) and (n,3n) reactions and σ_c is the sum of the cross sections of all processes which destroy a neutron. Upper and lower limits are derived for $\sigma_{n,\,2n}$, σ_c, and σ_{is} (inelastic scattering) for all materials investigated. For a number of materials specific values for the cross sections are obtained. (auth)

3647

NUCLEAR REACTIONS IN STARS. II. PROTONS ON LIGHT NUCLEI. E. E. Salpeter (Cornell Univ., Ithaca, N. Y.). Phys. Rev. 97, 1237-44(1955) Mar. 1.

The rates are calculated for thermonuclear reactions involving the collision of a proton with various light nuclei. These calculations are based directly on low-energy experiments for deuterium, Li, Be, and B, partly on experiments for O^{16}, and purely on theoretical estimates for the other isotopes of O, F, Ne, and Na. Temperatures are calculated at which D, Li, Be, and B are effectively destroyed by these reactions, both in the interior of young and cool stars which are still contracting gravitationally and in the outer layers of main sequence stars. It is shown that in the interior of even a hot main sequence star only O^{18} and F^{19} (and possibly O^{17}) are destroyed of all the isotopes heavier than nitrogen. (auth)

3648

GAMMA RAYS FROM PROTON BOMBARDMENT OF Li^6. S. Bashkin and R. R. Carlson (State Univ. of Iowa, Iowa City). Phys. Rev. 97, 1245-9(1955) Mar. 1.

A NaI(Tl) scintillation spectrometer, limited to 1.5-Mev gamma rays, detected 430 ± 20 kev radiation when separated Li^6 was bombarded with monochromatic protons from 180 kev to 415 kev. Spectrometer efficiency was measured using an Au^{198} source of beta-gamma coincidences. The thick target yield was $(7 \pm 4) \times 10^{-13}$ gamma per proton at 180 kev and $(170 \pm 35) \times 10^{-13}$ at 415 kev. The 430-kev gamma ray was interpreted as part of the cascade decay of the broad 6.35-Mev state of Be^7. Assuming s-wave capture, the experimental yield has been fitted with a Breit-Wigner resonance curve. At 415 kev, a cross section of 0.7 ± 0.2 μb is obtained for the decay of the capture state through the 430-kev state. This gives $(2J+1)\Gamma_\gamma$ a value of 1.0 ± 0.3 ev for this cascade process. The spectrometer, when unlimited, detected gamma rays corresponding to transitions from the capture level to the ground and 430-kev states. The number of transitions from the capture state to the 430-kev state of Be^7 is 35 ± 5 percent of the total radiative decays. Transitions through the 4.65-Mev state of Be^7 occur in less than 4 percent of the total radiative decays. (auth)

3649

ANGULAR DISTRIBUTIONS OF DEUTERON-INDUCED REACTIONS IN LITHIUM. S. H. Levine, R. S. Bender, and J. N. McGruer (Univ. of Pittsburgh, Penna.). Phys. Rev. 97, 1249-54(1955) Mar. 1.

Angular distributions of (d,t), (d,He^3), (d,p), and (d,d') reactions have been obtained using a natural lithium target. Butler type calculations for l = 1 transfer fit all of the above data except for the (d,d') reactions. A Q value of 0.974 ± 0.015 Mev has been assigned to the first excited level in Li^8. The He^5 ground state was observed with the two reactions $Li^7(d,\alpha)He^5$ and $Li^6(d,He^3)He^5$ for which the Q values were 14.26 ± 0.09 and 0.91 ± 0.09 Mev, respectively. (auth)

3650

GAMMA RAYS FROM 14-MEV NEUTRON BOMBARDMENT OF C^{12}. M. E. Battat and E. R. Graves (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 97, 1266-7(1955) Mar. 1.

The gamma rays emitted by C^{12} under 14-Mev neutron bombardment have been investigated with a three-crystal pair spectrometer. In the energy range 1.5 to 5.5 Mev, the observed pulse-height distribution is consistent with the assignment of a single-energy line at 4.4 Mev. The calculated value for the production cross section of 4.4-Mev gamma radiation is 245 ± 35 millibarns. (auth)

3651

TRITIUM PRODUCTION BY 2.2-BEV PROTONS ON IRON AND ITS RELATION TO COSMIC RADIATION. E. L. Fireman (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 97, 1303-4(1955) Mar. 1.

The cross section for tritium production by 2.2-Bev protons on iron is measured to be 62 ± 7 mb. This tritium cross section indicates that $(1.4 \pm 0.4) \times 10^{-3}$ tritons/g sec would be produced in small iron meteorites (a few inches in radius) in space by cosmic rays of the intensity of those striking the earth's polar regions. In 4×10^9 years, $(6 \pm 2) \times 10^{-6}$ cc of He^3 per gram of iron results from this cosmic-ray tritium. Mount Ayliff meteorite contains 11.5×10^{-6} cc of He^3 per gram, indicating its bombardment by a cosmic-ray flux at least as intense as is presently striking the earth. The variation of tritium with target depth is also measured and indicates a decrease less rapid than an attenuation due to geometric cross section. (auth)

3652

REACTION $p + p \rightarrow \pi^+ + d$. Frank S. Crawford, Jr. and M. Lynn Stevenson (Univ. of California, Berkeley). Phys. Rev. 97, 1305-13(1955) Mar. 1.

Absolute differential cross sections for the reaction $p + p \rightarrow \pi^+ + d$ have been measured at incident proton energies (lab system) from 310 to 338 Mev and at meson angles (c.m.) from 30° to 90°. The two final particles were counted in coincidence. The data are well fitted by the phenomenological theoretical expression

$$4\pi\frac{d\sigma}{d\Omega}(\text{c.m.}) = \alpha_{10\eta} + \beta_{10\eta^3}\frac{(x+\cos^2\theta)}{x+1/3},$$

with $x = 0.082 \pm 0.034$, $\alpha_{10} = (0.138 \pm 0.015) \times 10^{-27}$ cm², and $\beta_{10} = (1.01 \pm 0.08) \times 10^{-27}$ cm²; θ = meson c.m. angle and $\eta = p_\pi\,(\text{c.m.})/m_\pi c$. By measuring α_{10} the amount of S-wave in this reaction is determined. Further measurements with polarized protons of ~315 Mev are presented. These confirm directly the presence of interfering S- and P-waves and give a result $|Q| = 0.39 \pm 0.05$ for the asymmetry $(R-L)/(R+L)$ which would be obtained at 90° c.m. with 100 percent polarized protons. The polarized and unpolarized results are used together to determine the relative phases of the S- and P-wave mesons. Using the recent Chicago measurement of the sign of the proton polarization, the sign for meson production asymmetry shows that spin up protons produce more mesons to the right than to the left. The sign of this result, according to a theoretical prediction of B. T. Feld, provides strong evidence in favor of the Fermi type meson-nucleon interaction, and against the Yang type interaction. (auth)

3653

YIELDS OF PHOTONUCLEAR REACTIONS WITH 320-MEV X-RAYS. I. EXPERIMENTAL RESULTS. R. J. Debs, J. T. Eisinger, A. W. Fairhall, I. Halpern, and H. G. Richter (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 97, 1325-7(1955) Mar. 1.

Several medium weight target elements were irradiated by 320-Mev bremsstrahlung. For each target, relative yields were determined for the production of a number of radioactive nuclides. (auth)

3654

YIELDS OF PHOTONUCLEAR REACTIONS WITH 320-MEV X-RAYS. II. INTERPRETATION OF RESULTS. I. Halpern, R. J. Debs, J. T. Eisinger, A. W. Fairhall, and H. G. Richter (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 97, 1327-36(1955) Mar. 1.

It is convenient to separate the yields of radionuclides obtained in the work described in the preceding paper into two groups. The first group consists of the yields of nuclides which are only one or two mass units lighter than the target. All of the yields in this group, and especially those corresponding to (γ,n) reactions, are relatively large. They are due mainly to photons in the giant resonance region (hν~20 Mev) of the x-ray spectrum, and account for most of the nuclear events produced in medium-weight targets by 320-Mev x-rays. The yields of those radionuclides which are more than a few mass units lighter than the target are in many ways more interesting than the ones in the first group. They are found to exhibit a simple pattern very similar to those obtained in particle-induced high-energy reactions. It is shown that such patterns are at least qualitatively consistent with models of high-energy nuclear reactions in which the last few particles emitted from a struck nucleus, leave by "evaporation." Indeed the evaporation of these last particles exerts so strong an influence on the form of the observed yield pattern, that it becomes very difficult to say anything about either the nature of the original nuclear events or the emission of the first few particles on the basis of a study of yield patterns. Finally, a rough quantitative comparison is made of the yields of radionuclides and the reported yields of neutrons and other particles emitted from medium-weight nuclei irradiated with 320-Mev x rays. (auth)

3655

BERYLLIUM-7 PRODUCED BY COSMIC RAYS. James R. Arnold and H. Ali Al-Salih (Univ. of Chicago). Science 121, 451-3(1955) Apr. 1.

Be^7 with a half life of 53 days was produced by the high-energy interactions of cosmic rays in nitrogen. The picture presented for the formation of this nuclide includes the peak of the star production occurring about 15 km above the surface. The Be formed at this height forms BeO, or possibly $Be(OH)_2$, and the nonvolatile molecule diffuses in the atmosphere until it encounters a dust particle to which it adheres, and ultimately unites with other atmospheric dust particles to form cloud nuclei which are washed out by rain. Radiometric analysis of a series of rainwater and snow samples, using a low-level scintillation spectrometer with a 1 in. NaI(Tl) crystal, showed the occurrence of Be^7. The nature of the activity was verified in three ways. Methods of sample preparation are described, data on decay of activity in the samples are presented, and an estimate is presented of a world-wide Q value for Be^7. (C.H.)

3656

THE $^{12}C(\gamma,3\alpha)$ REACTION AND ENERGY LEVELS OF ^8Be AND ^{12}C. F. K. Goward and J. J. Wilkins (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Roy. Soc. (London) A228, 376-96(1955) Mar. 8.

The mechanism of the $C^{12}(\gamma, 3\alpha)$ reaction, for γ-ray energies, E_γ, up to about 40 Mev, has been determined from a study of over 2500 stars in nuclear emulsions. The study includes investigation of the angular distributions and correlations of the α particles. The reaction is initiated mainly by electric-dipole and electric-quadrupole γ-ray interaction, the former being unexpectedly strong when $E_\gamma < 20$ Mev. For $E_\gamma < 25$ Mev the reaction proceeds mainly by transitions to the ground state of Be^8(spin J = 0), and to 2.95 ± 0.10 Mev (J = 2) and 4.0 ± 0.1 Mev (J = 2 or 4) levels of Be^8. Transitions to levels near 6, 10, and 15 Mev (all J = 0, 2 or 4) become predominant when 25 Mev ≤ $E_\gamma < 26$ Mev. For $E_\gamma \geq 26$ Mev, most transitions lead to 16.8 ± 0.2 Mev (J = 2) and 17.6 ± 0.2 Mev (J = 2, possibly 0) levels, and possibly to a further 16.4 ± 0.2 Mev (J = 0 or 2) level, levels which have not been detected in other reactions. The reaction mechanism is interpreted in terms of competing modes of decay of a compound nucleus, demonstrating the strong influence of the isotopic spins (T) of the levels of C^{12} and Be^8 involved. For example, the 2^+ levels of C^{12} involved when 16 Mev ≤ $E_\gamma < 20$ Mev are (unexpectedly) found to have T = 1, and the 16.8 and 17.6 Mev levels of Be^8 are also found to have T = 1. The relationship of the $C^{12}(\gamma, 3\alpha)$ reaction to other C^{12} photodisintegration reactions (including some new reactions established during the present experiments) is discussed. (auth)

3657

THE RADIUM EQUIVALENT OF ^{24}Na SOURCES AND THE PHOTODISINTEGRATION CROSS SECTION OF DEUTERIUM. W. R. McMurray and C. H. Collie (Clarendon Lab., Oxford). Proc. Phys. Soc. (London) A68, 181-8(1955) Mar.

A stable β-detecting proportional counter has been constructed and used in the β-γ coincidence method to calibrate a Curie chamber substandard for Na^{24} γ-ray sources. The mg Ra equivalent of Na^{24} is found to be 0.333 ± 1.5% mc. This calibration leads to a revised value of the deuterium photodisintegration cross section at 2.76 Mev (15.05 ± 0.5 barns). (auth)

3658

THEORY OF (d,p) AND (d,n) REACTIONS. II. COULOMB CORRECTIONS AND NUMERICAL RESULTS. I. P. Grant (Clarendon Lab., Oxford). Proc. Phys. Soc. (London) A68, 244-56(1955) Mar.

The results of an earlier publication are generalized to take account of the effect of the Coulomb field on the differential cross section in a deuteron stripping reaction. The results, which are expressed in analytical form, have been compared in detail with the observations in two reactions using Be^9 as target nucleus at low energies. (auth)

3659

ANGULAR CORRELATION IN THE REACTION $^{14}N(d,\alpha\gamma\gamma)^{12}C$. J. Seed (Cavendish Lab., Cambridge, England). Phil. Mag. (7) 46, 100-2(1955) Jan.

The angular correlation between 3- and 4.5-Mev γ rays has been measured in the reaction $N^{14}(d,\alpha\gamma\gamma)C^{12}$. Targets of tantalum nitride were bombarded by 630-kev deuterons. Gamma rays emitted by the target were detected by 2 sodium iodide scintillation counters, the angle between which could be varied in the plane perpendicular to the incident deuterons. Coincidence γ-ray spectra were observed for 5 angles between the γ counters. At each angle, peaks at ~2.5 and 2 Mev appeared, corresponding to the 1-escape and 2-escape annihilation peaks of a 3-Mev γ ray in coincidence with the 4.5-Mev γ ray. The curve of number of coincidences as function of angle is plotted. This curve would result if the

7.68-Mev level has spin and parity (0+), giving a pure $0+ \rightarrow 2+ \rightarrow 0+$ transition involving 2 electric quadrupole γ rays. Odd parity for the level would give a similar result, and higher spins such as 3+ or 4± cannot be ruled out. (M.P.G.)

PARTICLE ACCELERATORS

3660 AECU-2995
Microwave Lab., Stanford Univ.
ELECTRON ORBITS IN THE BUNCHER OF A LINEAR ACCELERATOR. E. A. Smårs. Dec. 1954. 24p. Contract AT(04-3)-21. (ML-252)

The expressions for the fields in a traveling-wave linear accelerator are given. The equations of motion for an electron are derived under the assumption that the axial motion is independent of the transverse motion. An estimate is made of the maximum permissible d-c magnetic field at the cathode surface for negligible defocusing effect due to the remaining angular momentum of the electrons when leaving the focusing d-c magnetic field. The effect of the increasing accelerating field strength at the input and in the buncher on the focusing of the particles is discussed. By use of the parameters of the Stanford Mark III accelerator, and by numerical integration of the equations of motion, phase-curves and actual orbits are calculated for eight different phase entrance angles. From these curves it is concluded that as much as 75% of a beam injected parallel to the axis and filling the injection hole can be accelerated to the end of the 220-ft accelerator with a focusing d-c magnetic field applied only to the first 3 ft of the waveguide. (auth)

3661 CERN-PS/ER-40
[European Organization for Nuclear Research, Geneva] ON POLE PROFILES YIELDING LINEAR FIELDS. E. Regenstreif. Jan. 1955. 16p.

A theoretical approach to the determination of the pole profile of the proton synchrotron has been attempted by means of a Schwarz-Christoffel transformation applied to a simple generating structure. The computed profile was compared with a magnetically measured profile. (C.W.H.)

3662 UCRL-2698
Radiation Lab., Univ. of Calif., Berkeley
AN EXPERIMENTAL ION SOURCE FOR THE 184-INCH CYCLOTRON. Warren F. Stubbins. Feb. 1, 1955. 39p. Contract W-7405-eng-48.

A PIG type ion source was mounted in the center of the 184-inch cyclotron with extension lips placed on the dees to reduce the dee gap and aperture in the source region according to requirements established by calculations. The operation of the source and the nature of the cyclotron beam were observed for various conditions of dee voltage, dee bias, source position, and the time sequence of ion injection. A pulsewise increase of dee voltage at the ion injection time to achieve greater acceptance of ions was investigated. The restrictions imposed on the initial conditions for ions resulted in a decrease in the radial oscillation amplitude by a factor of 2 to 3. The beam current was comparable to that available from the conventional open arc source. (auth)

3663 UCRL-2818
Radiation Lab., Univ. of Calif., Berkeley
TESTING THE MAGNETIC FIELD OF THE BEVATRON Glen R. Lambertson. Nov. 10, 1954. 29p. Contract W-7405-eng-48.

The significant features of the bevatron magnetic field were examined in a program of magnetic measurements. Studies of the pulsed field employed an electronic integrator with special search coils. An oscilloscope pattern presenting data at about thirty magnet-current values per magnet pulse was photographically recorded. Although many new details were discovered, the behavior of the bevatron magnet was found to be consistent with model predictions. Some changes in the field distribution were necessary, but generally the magnet must be regarded as very satisfactory. (auth)

3664 UCRL-2822
Radiation Lab., Univ. of Calif., Berkeley
BEVATRON OPERATION AND DEVELOPMENT. III. [FOR PERIOD] AUGUST–OCTOBER 1954. Edward J. Lofgren and Harry G. Heard. Feb. 8, 1955. 28p. Contract W-7405-eng-48.

The improvement in over-all performance of the Bevatron this quarter may be gaged by the quantity of circulating beam that remains at 6 Bev. Beam magnitudes of greater than 10^9 protons per pulse can now be produced. Depending upon the injected beam amplitude, beam magnitudes as high as 10^{10} are frequently obtained. These increases in beam are the result of (a) a change in the overall value of the logarithmic field gradient of magnetic field, (b) location and elimination of various sources of low-level interference in the radiofrequency system, (c) reduction of timing jitter by improved regulation of magnet voltage and a reduction of the magnitude of magnetic field ripple as sensed by peaking strips. The localization of the various sources of beam loss is a result of a measurements program initiated during the last quarter. A summary description is given of these measurements, and the results are compared with the theory of nonlinear phase oscillations. Careful attention to some of the problems associated with the injection system has resulted in more reliable and stable performance. Much of the effort on the injection system was expended on the buncher, inflector, preexciter, and inflector power supply units. While no increase in peak injected beam was obtained, the average injected beam was increased. As much as 5% of the beam injected into the 10-Mev accelerator can be delivered to the magnet aperture at injection time. Fluctuations in intensity are limited to about ±10%. (For preceding period see UCRL-2692.) (auth)

3665
ELECTRON ACCELERATOR AND HIGH RESOLUTION ANALYZER. A. W. Blackstock, R. D. Birkhoff, and M. Slater (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr. 26, 274-5(1955) Mar.

The principle of energy measurement by stopping potential has been extended to high-energy electrons, using conventional accelerating tubes. Defocusing effects which occur during deceleration are minimized by employing a low-energy cylindrical electrostatic analyzer to measure the energy remaining in the beam after deceleration has been almost complete. The width of the line profile obtained by this technique appears to be largely independent of the primary energy of the electrons, the percent resolution thus improving as the primary energy is increased. Resolution up to 20 parts per million at 100 kev is obtainable by this method. (auth)

3666
PRODUCTION OF AN INTENSE PULSED BEAM OF DEUTERONS. F. Prévot and R. Vienet (Laboratoire des accel-

erateurs, C.E.A., Saclay). J. phys. radium 16, 238(1955) Mar. (In French)

A pulsed beam for a small Van de Graaff accelerator is provided by the design of a high-current pulsed ion source of the cold cathode type. Pulses of 1 μsec are produced every 260 μsec. A magnetic field of 200 gauss is provided by a coaxial winding, and the beam is extracted by impressing a 7000-volt pulse on an extractor electrode. A 9-ma, 1.55-Mev deuteron beam has been obtained. (K.S.)

RADIATION ABSORPTION AND SCATTERING

3667 CRP-584

Chalk River Project (Canada)

THE ELASTIC SCATTERING OF CHARGED PARTICLES BY NUCLEI. A. J. Ferguson. Aug. 1954. 47p. (AECL-157)

A formula for the elastic scattering of charged particles has been generalized so that the nuclear part of the scattering is represented by a general phase shift formula and not by a single resonance. The formula is based on the general phase shift representation of the scattering matrix. Possible simplifications are discussed. The scattering of charged particles is represented by Legendre polynomials and functions arising from the interference of the nuclear waves with the coulomb waves. A table of these functions is included to facilitate the calculation of angular distributions. (M.P.G.)

3668 AEC-tr-2107

THEORY OF SCATTERING OF FAST CHARGED PARTICLES. PART I. SINGLE SCATTERING BY THE SHIELDED COULOMB FIELD. Gert Molière. Translated from Z. Naturforsch. 2a, 133-45(1947). 20p. Available from Associated Technical Services (Trans. 19G5G), East Orange, N. J.

The quantum mechanical theory of the elastic single scattering by a shielded Coulomb field is developed by treating the shielding analytically according to the method of Thomas-Fermi. The theory is valid for arbitrary values of the parameter $\alpha \equiv zZ/(137\beta)$ [Z = atomic number of the scattering atoms, ± ze = charge of the scattered particles, v = velocity of the latter, $\beta = v/c$], as well as for the scattering angles $X \lesssim 90$ and for particles of kinetic energy $E_{kin} \gtrsim zZ^{4/3} \cdot 100$ ev. The influence of the spin, which is small at low scattering angles, has been neglected, so that the theory holds for any kind of charged particles. (auth)

3669

RANGE OF 208 ± 4-MEV PROTONS IN G5 NUCLEAR EMULSION. Hervasio G. De Carvalho, and Jerome I. Friedman (Univ. of Chicago). Rev. Sci. Instr. 26, 261-3(1955) Mar.

A range curve of the external beam of the University of Chicago synchrocyclotron was taken in G5 stripped nuclear emulsion. The range of this beam in copper was also measured in order to determine its energy. Having a mean range of 41.1 ± 0.1 g/cm^2 of copper, the beam had an energy of 208 ± 4 Mev according to Aron's tables. The mean range of the same beam in G5 nuclear emulsion at 47% relative humidity was 41.3 ± 0.2 g/cm^2 which is about 1.2% longer than that from Heinz's measurements and about 1.3% shorter than that calculated by Vigneron. At 47% relative humidity the average density of the emulsion was measured to be 3.85 ± 0.01 g/cm^3, in good agreement with the calculations of Wilkins. (auth)

3670

EXCHANGE SCATTERING OF NEUTRONS WITH 380 MEV-ENERGY ON DEUTERONS AND SPIN DEPENDENCE OF EXCHANGE FORCES. V. P. Dzhelepov, Yu. M. Kazarinov, and V. B. Flyagin (Inst. of Nuclear Problems). Doklady Akad. Nauk S.S.S.R. 100, 655-8(1955) Feb. 1. (In Russian)

3671

THE COULOMB SCATTERING OF HIGH-ENERGY ELECTRONS AND POSITRONS BY NUCLEI. R. M. Curr (Univ. Coll., London). Proc. Phys. Soc. (London) A68, 156-64(1955) Mar.

The Mott cross section for the Coulomb scattering of high-energy electrons and positrons by atomic nuclei has been expressed by McKinley and Feshbach in terms of series in powers of Z/137, up to terms in Z^4, where Z is the atomic number of the scattering nucleus. The coefficients of these series, which were evaluated numerically, have been recalculated and some minor errors corrected. Further coefficients have been calculated to enable application of the method to heavy elements and the resulting cross section, expressed as a ratio to the Rutherford cross section, is given in the form of a single power series. (auth)

3672

INELASTIC HEAVY PARTICLE COLLISIONS INVOLVING THE CROSSING OF POTENTIAL ENERGY CURVES. III. CHARGE TRANSFER FROM NEGATIVE IONS OF ATOMIC HYDROGEN TO PROTONS. D. R. Bates and J. T. Lewis (Queen's Univ of Belfast). Proc. Phys. Soc. (London) A68, 173-80(1955) Mar.

The Landau–Zener formula for the transition probability arising from the pseudo-crossing of potential energy curves is applied to the processes $H^-(1s)^2 + H^+ \rightarrow H(1s) + H(2s \text{ or } p)$, $H^-(1s)^2 + H^+ \rightarrow H(1s) + H(3s, p \text{ or } d)$, and $H(1s) + H(3s, p \text{ or } d) \rightarrow H(1s) + H(2s \text{ or } p)$, allowance being made for the effect of the orbital degeneracy. Cross sections and rate coefficients are given over a wide range of impact energies and temperatures. The calculations show that the electron transferred in slow encounters between H^- and H^+ ions falls mainly into the third quantum level. Recombination thus leads to the emission of the first Balmer line. The de-activation process studied is of interest in that it provides an illustration of a type of mechanism whereby electronic energy can readily be converted into translational energy in thermal collisions. (auth)

3673

THE TOTAL CROSS SECTIONS FOR THE NUCLEAR SCATTERING OF HIGH ENERGY NUCLEONS. K. M. Gatha and G. Z. Shah (M. G. Science Inst., Ahmedabad, India). Proc. Phys. Soc. (London) A68, 259-60(1955) Mar.

A theoretical analysis of total cross sections for the nuclear scattering of high-energy nucleons is presented, and results are reported for Be, C, O, Al, and S at 340 Mev. (L.T.W.)

3674

(γ,α), (γ,nα), AND (γ,t) REACTIONS ON THE ISOTOPES Br^{81}, Ag^{109}, K^{39}, AND O^{16}. J. Schmouker. J. phys. radium 16, 169-75(1955) Mar. (In French)

The reactions $Be^{81}(\gamma,\alpha)As^{77}$, $Ag^{109}(\gamma,\alpha)Rh^{105}$, $K^{39}(\gamma,n\alpha)Cl^{34}$ $O^{16}(\gamma,n\alpha)C^{11}$, and $O^{16}(\gamma,t)N^{13}$ were studied with γ rays of maximum energy 31.5 Mev. The activity of radioisotopes produced, measured after chemical separation, permits the calculation of total cross sections. The possibility of explaining the presence of α tracks in nuclear emulsions by these reactions is discussed. (tr-auth)

3675

SMALL-ANGLE SCATTERING AND SURFACE STRUCTURE. Yin-Yuan Li and R. Smoluchowski (Carnegie Inst. of Tech., Pittsburgh, Penna.). J. Appl. Phys. 26, 128-9(1955) Jan.

Small-angle scattering of x rays and thermal neutrons by submicroscopic irregularities on the surface of a solid is considered. The effect offers a possible method for measuring the average size of surface irregularities. (K.S.)

3676

ON THE DIFFUSION OF DECAYING PARTICLES. Louis Gold (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys. 26, 233-5(1955) Feb.

The probability of neutron absorption on a spherical surface for a radial source in a medium for which the particle has prescribed lifetime and rate of diffusion is calculated. This helps illuminate the more intricate, related problem for a charged particle diffusing in the presence of a radial inverse-square electric field to the extent that an explicit relation for the relative absorption probabilities that accompany changes in the direction of the drift field is secured. An asymptotic solution for the absorption probability is also provided which in first-order approximation may be applied in the range of interest for transistors. (auth)

3677

ANALYSIS OF SCINTILLATION SPECTROMETER OBSERVATIONS OF THE PENETRATION OF Cs^{137} GAMMA RADIATION THROUGH WATER. R. B. Theus, L. A. Beach, and W. R. Faust (Naval Research Lab., Washington, D. C.). J. Appl. Phys. 26, 294-7(1955) Mar.

Spectral modifications of Cs^{137} gamma radiations produced by penetration and diffusion through water have been observed. A single crystal of NaI(Tl) was used to observe the pulse-height distributions produced by radiation from both plane parallel and point isotropic sources. Inversion of the pulse-height distribution was carried out by use of an analog computer to obtain the spectral distribution of radiation. (auth)

3678

CROSS SECTION FOR EXCITATION OF Pb^{207m} BY INELASTIC SCATTERING OF NEUTRONS. P. H. Stelson and E. C. Campbell (Oak Ridge National Lab., Tenn.). Phys. Rev. 97, 1222-6(1955) Mar. 1.

The cross section for the excitation of the 0.8-sec-metastable state of Pb^{207} by inelastic neutron scattering has been measured for neutron energies up to 3.1 Mev. Neutrons were produced by the Li(p,n) reaction. The lowest neutron energy for which excitation is observed is 1.6 Mev. This is in agreement with the level scheme for Pb^{207} based on other information. For the first 800 kev above threshold, the cross section rises approximately linearly, attaining a value of 75 millibarns at 2.4 Mev. After leveling off, it abruptly increases at 2.75 Mev and has a value of 190 millibarns at 3.1 Mev. It is judged that the absolute values of the cross section are accurate to ±40 percent. The absolute cross section for excitation of the metastable state as a function of neutron energy is calculated by the use of the strong interaction theory of nuclear reactions. The theoretical predictions agree well with the measured curve. (auth)

3679

GAMMA RADIATION FROM THE INELASTIC SCATTERING OF PROTONS BY F^{19}. C. A. Barnes (California Inst. of Tech., Pasadena). Phys. Rev. 97, 1226-33(1955) Mar. 1.

The absolute cross section for the excitation of the 109-kev and 197-kev excited states of F^{19}, by the inelastic scattering of protons, has been studied as a function of bombarding energy up to 1750 kev by detecting the resultant gamma radiation in scintillation counters. Most of the resonances for the various $F^{19}(p,\alpha)O^{16}$ reactions appear as resonances for the excitation of one or both of these low-lying states. A detailed study of the angular distributions of the two gamma rays, together with the direct measurements of the lifetimes of these states by Thirion, Barnes, and Lauritsen, and the Coulomb excitation work of Sherr, Li, and Christy, leads to the assignments: 109-kev state, $J = \frac{1}{2}$, odd parity; 197-kev state, $J = \frac{5}{2}$, even parity. The nonresonant yield of 197-kev gamma rays is approximately that expected from Coulomb excitation at low incident proton energies. The nonresonant yield of 109-kev gamma rays exceeds the expected Coulomb excitation. In conjunction with the recent measurements of the elastic scattering of protons by F^{19} made by Peterson, Webb, Hagedorn, and Fowler, in this laboratory, and older measurements of the $F^{19}(p,\alpha)O^{16}$ reactions, the resonant inelastic cross sections allow a new determination of the partial widths for the various modes of decay of the Ne^{20} compound and nuclear states. (auth)

3680

POLARIZATION OF NUCLEONS ELASTICALLY SCATTERED FROM NUCLEI. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 97, 1314-24(1955) Mar. 1.

The polarization P of nucleons elastically scattered from nuclei has been calculated for the nuclear potential of Woods and Saxon which has the radial dependence $1/\{1+\exp[(r-r_0)/a]\}$, where r_0 is the nuclear radius and the parameter a determines the length of the exponential tail. The variation of P with the optical parameter k_1/K and the strength of the spin-orbit coupling was investigated for the case of Al. In general, P remains positive throughout the first diffraction minimum. For the Berkeley data for the polarization of 300-Mev protons scattered from Al, a reasonable fit has been obtained inside the first diffraction peak. The functions β and R introduced by Wolfenstein to describe the asymmetry in a triple scattering experiment are evaluated for several cases. (auth)

3681

SCATTERING OF FAST NEUTRONS AND PROTONS BY ATOMIC NUCLEI. Gyo Takeda and K. M. Watson (Univ. of Wisconsin, Madison). Phys. Rev. 97, 1336-43(1955) Mar. 1.

The effects of the Pauli principle on the analysis of the scattering of fast neutrons and protons by atomic nuclei are considered. This modifies the usual multiple scattering treatment of such problems in three ways: (1) It is necessary to agree on a convention for deciding which are "scattered" and which are "nuclear" nucleons. (2) The two-body scatterings obtained from the impulse approximation must be properly antisymmetrized. (3) Exchange corrections occur because of the non-orthogonality of the plane wave states for scattered particles and the states for bound particles. The latter corrections seem to be negligible for energies sufficiently high that the multiple-scattering approach is expected to be useful anyway. The present analysis is also applicable to other types of multiple-scattering problems. (auth)

RADIATION EFFECTS

3682

THERMOLUMINESCENCE AND FLUORESCENCE IN ALKALI HALIDE CRYSTALS INDUCED BY SOFT X-RAY.

Seymour P. Keller and Jackson J. Clemmons (Univ. of Wisconsin, Madison). J. Chem. Phys. 23, 586-7(1955) Mar.

The resultant fluorescence and thermoluminescence of LiF, NaI, NaCl, KCl, KBr, KI, RbBr, and CsBr crystals which had been irradiated with soft x rays with energies between 1 and 7 kv are described. (C.W.H.)

RADIOACTIVITY

3683

SEARCH FOR DOUBLE BETA DECAY IN Ca^{48}. John A. McCarthy (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 97, 1234-6(1955) Mar. 1.

If double beta decay occurs without the emission of neutrinos, the total kinetic energy of the two emitted electrons is constant. An experiment has been performed using this constancy of energy and the coincidence nature of the activity in an attempt to observe and identify this process in Ca^{48}. The results show a peak in the total energy spectrum at 4.1 ± 0.3 Mev. Mass spectrographic data gives 4.3 ± 0.1 Mev as the available energy for double beta decay. The author believes this to be evidence for double beta decay without neutrino emission unless the observed counts are due to an unusual phenemenon of unknown origin. (auth)

3684

ISOMERIC STATE OF Y^{88} IN THE DECAY OF Zr^{88}. E. K. Hyde, M. G. Florence, and A. E. Larsh (Univ. of California, Berkeley). Phys. Rev. 97, 1255-8(1955) Mar. 1.

The 85-day activity Zr^{88} decays by electron capture to Y^{88m} which de-excites by emission of 395-kev gamma radiation with a half life of 0.37 ± 0.03 millisecond. From the half life and the conversion coefficient the transition is characterized as E3. (auth)

3685

ANGULAR DISTRIBUTION OF THE RESONANCE FLUORESCENCE RADIATION FROM THE 411-KEV EXCITED STATE OF Hg^{198}. Franz R. Metzger (Bartol Research Foundation of the Franklin Inst., Swarthmore, Penna.). Phys. Rev. 97, 1258-60(1955) Mar. 1.

By using the Doppler broadening due to thermal agitation at elevated temperatures as a means of restoring the resonance condition, the angular distribution of the resonance fluorescence radiation from the 411-kev excited state in Hg^{198} has been measured. The observed distribution has the form $1+ (0.37 \pm 0.06)P_2(\cos\theta) + (1.07 \pm 0.08)P_4(\cos\theta)$, which agrees very well with the theoretical expectation for the excitation of a state with spin 2 from a ground state with spin 0. (auth)

3686

COINCIDENCE STUDIES OF THE DISINTEGRATION OF Pm^{151} AND Nd^{147}. Harnam Singh Hans, Babulal Saraf, and C. E. Mandeville (Bartol Research Foundation of the Franklin Inst., Swarthmore, Penna.). Phys. Rev. 97, 1267-71(1955) Mar. 1.

Chemically pure Nd_2O_3 was irradiated by slow neutrons on five successive occasions in the Brookhaven pile. The 27.5-hour Pm^{151} was found to emit gamma rays of energies 64, 100, 163, 177, 240, 275, 340, 440, 650, and 700 kev. The 11-day Nd^{147} was shown to emit quanta of energies 92, 165, 280, 320, 410, 440, 530, and 690 kev. The relative intensities of the various quantum radiations have been determined, and coincidence measurements have been performed to ascertain the various sequential relationships between pairs of gamma rays. Partial decay schemes for both radionuclides have been indicated. (auth)

3687

DECAY OF Ti^{51} AND Cr^{51}. M. E. Bunker and J. W. Starner (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 97, 1272-5(1955) Mar. 1.

The radiations of Ti^{51} (5.8 min) and Cr^{51} (27 day) have been investigated with beta- and gamma-scintillation spectrometers. Gamma rays having energies of 0.323, 0.605, and 0.928 Mev and relative intensities of 95.8:1.4:4.2, respectively, were observed to accompany the decay of Ti^{51}. Two beta groups were observed of energy 2.13 and 1.5 Mev, having relative intensities of 94.4 and 5.6, respectively. The 2.13-Mev transition leads to the 0.323-Mev level of V^{51}. There is no evidence for a beta transition to the ground state of V^{51}. Cr^{51} decays by electron capture to both the ground state and the first excited state of V^{51}. The intensity of the capture branch to the 0.323-Mev level was measured to be 9.8 percent. A value of 3.25×10^{-3} was found for the total internal conversion coefficient of the 0.323-Mev gamma transition, indicating that the transition is M1 + E2. The spin and parity assignments suggested by the experimental data are discussed. (auth)

3688

NEUTRON DEFICIENT ISOTOPES OF Pb AND Tl. I. ISOMERS OF Pb AND Tl. I. Bergström and A. H. Wapstra (Nobel Inst. of Physics, Stockholm, Sweden). Phil. Mag. (7) 46, 61-4(1955) Jan.

Preliminary results of an extensive investigation of Pb and Tl isotopes are reported. Pb was irradiated with 60-Mev protons, and its activity was counted. The isomeric levels interpreted from the results are discussed and compared with other experimental evidence. (M.P.G.)

3689

NEUTRON DEFICIENT ISOTOPES OF Pb and Tl. II. MASS NUMBERS 204, 202, 201, AND 200. K. E. Bergkvist, I. Bergström, C. J. Herrlander, S. Hultberg, H. Slatis, E. Sokilowski, A. H. Wapstra, and T. Wiedling (Nobel Inst. of Physics, Stockholm, Sweden). Phil. Mag. (7) 46, 65-9(1955) Jan.

The decay of $Pb^{200-202}$ has been investigated. Tl was bombarded with deuterons and protons. The lead activities were evaporated in vacuum on to thin foils and used as sources in a β spectrometer. Conversion electrons were investigated in the energy region 10 to 1600 kev. The preliminary results are presented, including energy values, K-conversion intensities, and K/L ratios. (M.P.G.)

3690

NEUTRON DEFICIENT ISOTOPES OF Pb AND Tl. III. MASS NUMBERS BELOW 200. G. Andersson and E. Arbman (Gustaf Werner Inst. for Nuclear Chemistry, Uppsala, Sweden) and I. Bergström and A. H. Wapstra (Nobel Inst. of Physics, Stockholm, Sweden). Phil. Mag. (7) 46, 70-2(1955) Jan.

The decay schemes of isotopes of Pb and Tl with mass numbers below 200 are being investigated. The activities produced by Tl(p,xn) reactions in a synchrocyclotron have been studied in a β spectrometer. The conversion electron spectrum has been investigated in the region 50 to 700 kev. All the activities except Pb^{199+} were shown to decay by electron capture. The preliminary results are summarized. (M.P.G.)

3691

THE HALF-LIFE OF Sr^{90}. D. M. Wiles and R. H. Tomlinson (McMaster Univ., Hamilton, Ontario, Canada). Can. J. Phys. 33, 133-7(1955) Mar.-Apr.

The value of 27.7 ± 0.4 years has been obtained for the half life of Sr^{90} from the absolute disintegration rate of a known number of atoms. The disintegration rate was measured with a 4π proportional counter and the number of atoms was determined with a mass spectrometer using isotope dilution. (auth)

3692

AN EXPERIMENTAL LAW, SIMPLY DERIVED, FOR THE α DISINTEGRATION ENERGY OF HEAVY RADIOELEMENTS. Frederic Roger. Compt. rend. 240, 858-9(1955) Feb. 21. (In French)

If the α disintegration energy of a radioelement is expressed in Mev, the following relationship is established for the disintegration energy of nuclei with $Z \geq 84$ and $N \geq 128$:

$$E = 9 - \frac{(N-128)}{6}\,\frac{(102-Z)}{6}.$$ (K.S.)

3693

MEASUREMENT OF THE HALF LIFE OF RaD (Pb^{210}). Jacques Tobailem (Institut du Radium, Paris). J. phys. radium 16, 235-6(1955) Mar. (In French)

The half life of Pb^{210} is found to be 19.40 ± 0.35 yr, with a decay constant of $(1.13 \pm 0.02) \times 10^{-9}$/sec. The precision of the measurement is 1.8%. (K.S.)

3694

ON THE γ RADIATION ACCOMPANYING THE DISINTEGRATION OF As^{77}. H. Langevin (College de France, Paris). J. phys. radium 16, 238-40(1955) Mar. (In French)

RARE EARTHS AND RARE-EARTH COMPOUNDS

3695

THE MAGNETIC SUSCEPTIBILITY OF METALLIC NEODYMIUM. L. F. Bates, S. J. Leach, R. G. Loasby, and K. W. H. Stevens (Univ. of Nottingham). Proc. Phys. Soc. (London) B68, 181-2(1955) Mar.

The magnetic susceptibility of neodymium has been measured over the temperature range 290 to 1000°K. The absolute mass susceptibility was determined at 295°K. The experimental temperature variation of susceptibility over the range 290 to 500°K agrees well with the theoretical value; however, above 500°K, an explanation in terms of changes in population of levels was necessary. (C.W.H.)

SPECTROSCOPY

3696 AD-15991

Research Foundation, Ohio State Univ.

AN ELECTRON SPECTROMETER FOR THE STUDY OF INELASTIC COLLISION CROSS SECTIONS. E. N. Lassettre, A. S. Berman, S. Silverman, and M. E. Krasnow. Jan. 1953. 75p. Contract AF19(122)-642, Scientific Report No. 2.

A detailed description is presented of the theory, construction, and performance of an electron spectrometer suitable for obtaining electron impact energy spectra for incident electron energies from 100 to 600 v, and for the measurement of collision cross sections using incident electron energies between 400 and 600 v. A typical cross-section determination is included to illustrate the specific procedure used. (auth)

3697

SOFT X-RAY SPECTRA OF MAGNESIUM–ALUMINIUM, MAGNESIUM–SILICON, AND ALUMINIUM–SILICON ALLOYS. K. Das Gupta and E. Wood (Univ. of Liverpool, England). Phil. Mag. (7) 46, 77-86(1955) Jan.

The soft x-ray L spectra of the elements Mg, Al, and Si have been determined in all three of the sets of binary systems and have been compared with the spectra of the pure elements. Several differences appear: (a) a widening of the emission edges with alloying, (b) in one case a probable diminution of band width, and (c) structural changes in the shapes of the bands. These effects can be understood on the assumption that the systems consist of two or more phases. No case of identity of the bands of the two constituents, such as might be expected from a perfectly ordered single-phase system, has been found. (auth)

3698

NEW DETERMINATION OF THE K ABSORPTION FREQUENCIES OF CESIUM (55) AND BARIUM (56). Pierre Callon. Compt. rend. 240, 854-5(1955) Feb. 21. (In French)

THEORETICAL PHYSICS

3699

BETA-RAY SPECTRA. I. Hisao Takebe (Univ. of Tokyo). Progr. Theoret. Phys. (Japan) 12, 561-73(1954) Nov.

Probabilities of β-decay transitions forbidden to any degree have been calculated in the case of the linear combination of the Fermi interactions, with some corrections taken into account. (auth)

3700

BETA-RAY SPECTRA. II. Hisao Takebe (Univ. of Tokyo). Progr. Theoret. Phys. (Japan) 12, 574-7(1954) Nov.

The relation between the many-particle and the single-particle matrix element is calculated in the jj coupling scheme. (auth)

3701

SPIN ORBIT COUPLING AND THE MESONIC LAMB SHIFT. E. W. Laing (Univ. of Glasgow, Scotland). Phil. Mag. (7) 46, 106-8(1955) Jan.

Self-energy corrections for a nucleon moving in a scalar potential well have been shown to lead to a strong spin-orbit coupling for pseudoscalar meson fields with pseudoscalar coupling. Assuming charge symmetric meson theory, a spin orbit coupling was obtained of the right order of magnitude but of the wrong sign for application to the nuclear shell model. The present note shows that a more detailed investigation of the total matrix element reveals contributions to the spin-orbit coupling from the small components of the initial and final spinor wave functions. These contributions are such that they reverse the sign of the spin-orbit coupling while leaving its magnitude unchanged. The results obtained afford a possible field theoretical picture for the nuclear shell model. (M.P.G.)

3702

BEHAVIOR OF NEUTRAL PARTICLES UNDER CHARGE CONJUGATION. M. Gell-Mann (Columbia Univ., New York) and A. Pais (Institute for Advanced Study, Princeton, N. J.). Phys. Rev. 97, 1387-9(1955) Mar. 1.

Some properties are discussed of the θ^0, a heavy boson that is known to decay by the process $\theta^0 \rightarrow \pi^+ + \pi^-$. According to certain schemes proposed for the interpretation of hyperons and K particles, the θ^0 possesses an antiparticle $\bar{\theta}^0$ distinct from itself. Some theoretical implications of this situation are discussed with special reference to charge conjugation invariance. The application of such invariance in familiar instances is surveyed in Sec. I. It is then shown

in Sec. II that, within the framework of the tentative schemes under consideration, the θ^0 must be considered as a "particle mixture" exhibiting two distinct lifetimes, that each lifetime is associated with a different set of decay modes, and that no more than half of all θ^0's undergo the familiar decay into two pions. Some experimental consequences of this picture are mentioned. (auth)

3703

FUNCTIONAL ANALYSIS AND STRONG-COUPLING THEORY. J. Hamilton (Christ's Coll., Cambridge, England). Phys. Rev. 97, 1390-1(1955) Mar. 1.

The relation of functional analysis to the Hamiltonian approach to strongly interacting quantized fields is examined. The propagation of fermions in an external unquantized boson field provides the basis for the solutions, as in the Green function method. The functional method may be useful in studying real nucleons and bound states. (auth)

3704

BOSON-FERMION SCATTERING IN THE HEISENBERG REPRESENTATION. F. E. Low (Univ. of Illinois, Urbana). Phys. Rev. 97, 1392-8(1955) Mar. 1.

It is shown that the S-matrix for boson-fermion scattering can be simply expressed in the Heisenberg representation. By performing a time integration one obtains the S-matrix in the Schrödinger representation, which has the same form as the conventional perturbation theory sum over states. Suitably limiting the nature of the intermediate states entering into this sum leads to integral equations for certain matrix elements which are equal to the S-matrix elements on the energy shell. These equations appear in a completely renormalized form. For example, in the fixed source limit, the four pion-nucleon scattering states satisfy the same equation (with different numerical coefficients). The equations are nonlinear, but involve only the scattering phase shifts. The equivalent equation for photopion production is linear, and in the fixed source limit can be written down from a knowledge of the experimental scattering phase shifts. The zero-pion-mass theorems of Gell-Mann and Goldberger (concerning the isotopic spin independence of the zero-energy S-wave scattering) and of Kroll and Ruderman, [Phys. Rev. 93, 233 (1954)] follow simply from the formalism. (auth)

3705

STRONG-COUPLING THEORY FOR THE CASE OF PSEUDOSCALAR COUPLING. Hironari Miyazawa (Univ. of Chicago). Phys. Rev. 97, 1399-1406(1955) Mar. 1.

The pseudoscalar pion field in interaction with the nucleon field through the symmetric pseudoscalar coupling is quantized by using the lattice space method. A strong-coupling approximation is employed to diagonalize the Hamiltonian at each point. The vacuum is represented by a set of rotators, each having excited states. Propagation of this excitation through the lattice points has the character of particles, which are identified as pions and excited states of pions. Nucleons are found to have excited states, the lowest of which has isotopic spin $\frac{1}{2}$ and parity opposite to that of the ground state (one nucleon). In the pion-nucleon scattering, this state causes a strong attractive force for S waves with $I = \frac{1}{2}$ and explains the qualitative behavior of S-phase shifts. (auth)

3706

SACHS' THEOREM ON THE MAGNETIC MOMENTS OF NUCLEONS. Hironari Miyazawa (Univ. of Chicago). Phys. Rev. 97, 1413-14(1955) Mar. 1.

A correction due to nucleon-pair creation is given to Sachs' relationship between the sum of nucleon magnetic moments and the probability of virtual pions forming the state of angular momentum one. It is found that the probability determined by Sachs is considerably modified by this correction. (auth)

DEUTERON STRIPPING AND THE COLLECTIVE NUCLEAR MODEL. G. R. Satchler (Clarendon Lab., Oxford, England). Phys. Rev. 97, 1416-17(1955) Mar. 1.

Expressions for the reduced widths for nucleon capture into low nuclear levels reached by deuteron stripping have been derived previously by using the nuclear shell model. This note considers the effects of collective motion in nuclei. (auth)

3708

THE NUCLEON GREEN FUNCTION IN CHARGED MESON THEORY. S. F. Edwards (Univ. of Birmingham, England). Proc. Roy. Soc. (London) A228, 411-24(1955) Mar. 8.

The method of functional integration is used on the problem of obtaining the nucleon Green function including radiative corrections in charged scalar meson theory without nuclear recoil. An explicit functional integral for the solution in the presence of an external field is given, and since this cannot be evaluated explicitly a general method is proposed for an approximate evaluation. The method is illustrated by solutions for weak and strong coupling, and the structure of these solutions is discussed. (auth)

3709

MILNE'S PROBLEM WITH A POINT-SOURCE. J. P. Elliott (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Roy. Soc. (London) A228, 424-33 (1955) Mar. 8.

Asymptotic solutions have been found, if capture is small, in the Milne problem with a point source either on the boundary or in the scattering half-space. (auth)

3710

THEORY OF NUCLEAR REACTIONS WITH FORMATION OF SLOW PARTICLES. A. B. Migdal. Zhur. Eksptl'. i Teoret. Fiz. 28, 3-9(1955) Jan. (In Russian)

Expressions for the energy and angular distribution of slow nucleons formed in collisions between nucleons and deuterons and between deuterons and nuclei are derived. The probability of formation of nucleons in bound states is considered. (G.Y.)

URANIUM AND URANIUM COMPOUNDS

3711 AEC-tr-2100

URANIUM AS FISSIONABLE MATERIAL IN NUCLEAR REACTORS. K. Stockland and H. Chr. Neeb. Translated from Forsvarets Forskningsinstitutt Arbok III, 17-27 (1950-51). 15p. Available from Henry Brutcher (Trans. No. 3475), Altadena, Calif.

The most commonly used methods of refining U and of producing metallic U or UO_2 are reviewed. The production of reactor fuel rods from UO_2 and metallic U is described. The paper is based chiefly on American and French literature on the subject. (M.P.G.)

3712

REVIEW OF THE MEASUREMENTS OF THE RESONANCE ABSORPTION OF NEUTRONS BY URANIUM IN BULK. E.

Creutz, H. Jupnik, T. Snyder, and E. P. Wigner (Princeton Univ., N. J.). J. Appl. Phys. 26, 257-9(1955) Mar.

Early investigations on the feasibility of maintaining a chain reaction with U are reviewed in light of recently declassified information. Particular attention is given to problems encountered in the period 1939-42 with resonance absorption in U^{238} and the distribution of U in a moderating matrix. (K.S.)

3713

RESONANCE ABSORPTION OF NEUTRONS BY SPHERES. E. P. Wigner, E. Creutz, H. Jupnik, and T. Snyder (Princeton Univ., N. J.). J. Appl. Phys. 26, 260-70(1955) Mar.

By concentrating uranium into lumps, one can decrease its resonance absorption as compared with the resonance absorption of the same amount of uranium spread out uniformly in a moderator. It is shown here that this decrease is caused principally, not by the diminished over-all density of the neutrons at the lump, but by their changed energy distribution. This shows deep minima at the resonance lines, i.e., where the uranium absorbs most strongly. The considerations here presented show that the decrease in absorption is largest for the low energy resonances of U^{238} which are responsible for the bulk of the absorption in the case of uniform distribution. As a result, the resonance absorption of uranium lumps extends over a very large energy region—up to about 5000 ev. It can be decomposed, approximately, into two parts: the mass absorption, proportional to the number of U^{238} atoms present; and a surface absorption, proportional to the surface of the lump. The total decrease of the resonance absorption produced by lumping (the "advantage factor" of lumping) can be estimated to reach, under favorable conditions, a value as high as 20. (auth)